FIFTH REPORT OF

THE BUREAU OF MINES

1895.

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To His Honor GEORGE AIREY KIRKPATRICK,

Lieutenant-Governor of Ontario:

I have the honor to transmit herewith, for presentation to the Legislative Assembly, the Fifth Report of the Bureau of Mines.

I have the honor to be, Sir,

Your obedient servant,

A. S. HARDY,

Commissioner of Crown Lands.

DEPARTMENT OF CROWN LANDS,

Toronto, March 31, 1896.

FIFTH REPORT OF

THE BUREAU OF MINES.

To the Honorable ARTHUR S. HARDY,
Commissioner of Crown Lands :

SIR,—The Fifth Report of the Bureau of Mines is submitted to you herewith, for presentation to His Honor the Lieutenant-Governor.

Besides the statistics of mineral lands sold and leased by the Crown, and the quantities and values of metallic and non-metallic mineral productions of the Province during the year, this Report deals with a variety of subjects related to the development and progress of our mining industry. Scope of the Report.

The increasing interest evinced by explorers, miners and moneyed men in the gold districts of the Province, and the promising discoveries reported from time to time in new fields, appeared to call for a further and an extended examination of the formations which were believed to be gold-bearing. Accordingly Dr. Coleman was instructed to continue the work which he had commenced in 1894, and to report upon all areas north and west of lake Superior in which gold had been found. Besides the districts upon the Seine river from Steep Rock lake to Rainy lake, along the Manitou and Wabigoon rivers from Rainy lake to Wabigoon lake, and parts of Lake of the Woods, he visited and examined the tract of country from Wabigoon lake to Lonely lake on the northern boundary of the Province; the region south and south-west of Lac des Mille Lacs, bordering upon Shebandowan and Round lakes, including Moss township; a section in the valley of Mattawin river, along Gold creek; and a locality near Jackfish bay, on the north shore of lake Superior. The Doctor visited also a number of important iron ore locations along Mattawin river, and Silver Islet in lake Superior, some accounts of which are given in the report of his explorations. Gold areas north and west of lake Superior. Iron ores in the Mattawin valley.

A geological map of the regions of Seine river and Rainy lake and of the Manitou and Wabigoon rivers, with all surveyed mining locations laid down upon it, accompanies the text of Dr. Coleman's report. It will no doubt prove valuable to prospectors and miners. Map of the gold regions.

Gold mines and mills in Rainy lake and Lake of the Woods districts.

I accompanied Dr. Coleman in his excursion from Savanne to Moss township and from lake Shebandowan to the iron ore locations in the Mattawin valley, and afterwards proceeded by Lac des Mille Lacs and the Atik-okan river to inspect mines and mining prospects along the Seine river and on Lake of the Woods. Six stamp mills have been erected in those districts for treating gold ores, with an aggregate of sixty stamps, two of which are on the Seine river and four on Lake of the Woods. Five of these were in operation for a few weeks only, owing to insufficient development of the mines; but one of the five has been running steadily since September. The Sultana mine supplied a ten-stamp mill with ore constantly during the year, the main shaft of which has reached a depth of 200 feet and is in good ore throughout. The total gold production of the two districts last year was about $50,000; and as development work has been pursued at a number of points during the autumn and winter, it is confidently expected that the yield will be largely increased this year. Upon returning to Port Arthur I had an opportunity to visit Silver Islet, Edward's island and the east shore of Black bay. At Sudbury I visited the extensive works of the Canadian Copper Company, where mining and smelting operations were actively carried on; and subsequently the Mammoth mine, the gold property of the Bonanza Nickel Mining Company in the township of Maclennan, near lake Wahnapitæ, where the Government diamond drill was at work. A narrative of my tour forms a section of the Report; and many notes and observations of the country made and gathered by the way, bearing on its geology, physical geography, forests, soil, etc., have been utilized for a section on The New Ontario.

In the Sudbury district.

The New Ontario.

Employment of the Government diamond drill.

The diamond drill was employed last year upon two locations. For nearly six months it continued the work undertaken at the end of 1894 to explore the Glendower iron mine in Frontenac, and for nearly three months following it was run at the Mammoth mine. The data of these operations have been used by Mr. Gibson, secretary of the Bureau, along with similar data collected from other sources, to show the rate of speed at which the process of drilling can be carried on in rocks, minerals and ores of different kinds, together with the cost and efficiency of this method of exploration, and other features of practical interest.

The Hamilton blast furnace.

The completion of the blast furnace at Hamilton is an event of significant importance in the progress of mining and metallurgic enterprise in Ontario, and a description of the works is given in the first section. There is reason to believe that the demand for ore which this furnace must establish will lead to the opening up and working of a number of the many iron deposits which are known to exist in our Province.

Exploring north of the height of land.

As a result of explorations conducted during the past forty years, it is demonstrated that the largest and most valuable ore bodies in Ontario are to be looked for in rocks of the Huronian formations, and wherever these occur they deserve to be carefully examined. Extensive areas of them are known to exist beyond the height of land, and the time cannot be distant now when the attention of prospectors will be drawn towards them. In anticipation of such a movement it has been deemed advisable to procure information on the best means of access to these Huronian fields, which lie far beyond the range of existing settlements and even beyond the limits of lumbering operations. Mr. Edward B. Borron, an experienced and capable miner who has made a number of trips across the country to James bay in his capacity of stipendiary magistrate for the northern part of Nipissing district, was employed last year to report upon rock formations along the height of land, with special reference to Huronian tracts and the best way of reaching them by canoe routes from south to north. The section allotted to him extends from White river to the Spanish, but on account of illness he was able to examine only a portion of it towards the west, where the formation appears to be chiefly Laurentian. The most interesting as well as most promising part remains to be explored, and in particular the northern extension of the great Huronian belt beyond Sudbury and lake Wahnapitæ to the headwaters of the Mattagami, the Montreal and Abitibi rivers.

The petroleum industry.

The recent rise in the price of petroleum led during the past year to the drilling of many wells in the Petrolea and Oil Springs districts, and in other localities where there was reason to believe that oil might be found. Along the south branch of the Sydenham river, in Euphemia township, several wells were bored which yielded a small flow, and operations have also been commenced in the old Bothwell field in the townships of Zone, Orford and Aldborough. A new field began to be exploited on Pelee island in lake Erie a year ago, by a syndicate now organized as the Pelee Gas and Oil Company. The first well was bored in the northeast corner of the island to a depth of 938 feet, when salt water was struck. The site for a second well was selected on the Dyke road near the western side of the island, where in October a small flow of oil was reached at 833 feet. A third well was started in November a mile and a half south of the second, and on the 7th inst., at a depth of 750 feet, oil was struck which spurted out of the bore hole to the top of the derrick, a height of 35 feet, but the capacity of it is not yet known. A strong flow of gas accompanies the oil.

Mining accidents.

The section of the Report devoted to mining accidents shows that the number occuring has been fewer than in previous years, and that excepting in the case of a fire at the Sultana mine, in which one man lost his life, there

are no fatal casualties to record for mines or works over which the Bureau has heretofore had jurisdiction. One death resulted from a premature explosion in a prospecting shaft where only two persons were employed, but under section 53 of The Mines Act 1892 the mining regulations do not apply to any mine "unless more than six persons other than the owner are employed under ground." The amending Act which has received its third reading to-day makes the regulations apply to all mines and works.

Summer Mining Schools.

The appropriation made by the Legislature last year for Summer Mining Schools was placed at the disposal of the Kingston Mining School, and classes were held during the year under the direction of Wm. Hamilton Merritt, Assoc. R.S.M., at Mine Centre, Rat Portage, Port Arthur, Sault Ste. Marie and Sudbury. An account of the work done at those schools, as well as at the Kingston School of Mining, is added to this Report; as also a description of the mill set up in the School of Practical Science last year for treating gold ores.

The Inspector's report.

The report of the Inspector of Mines, made to me under date of March 14, accompanies this Report and forms part of it.

I have the honor to be, Sir,

Your obedient servant,

ARCHIBALD BLUE,

Director.

BUREAU OF MINES,

Toronto, March 30, 1896.

SECTION I.

GENERAL INTRODUCTION.

Although Ontario is a Province of large extent, and embraces within its boundaries geological formations from the lowest and oldest up to but unfortunately not including the coal measures, and although evidences abound of the richness and variety of its mineral wealth, it is not yet possible to speak of it as a country possessing a well established mining industry. In some directions we are making progress, and year by year confidence is growing that capital and labor will find a generous reward when employed in opening up the hidden treasures of our rocks; but in the minds of most people the rate of progress is painfully slow, and in some minds there are doubts if the treasures really exist anywhere. Meantime the hardy explorers are busily employed in search of minerals, and reports of new discoveries are heard from quarters of the Province heretofore not suspected of possessing ores or minerals of any kind, and locations are being taken up, and men with money at their credit in the banks are making investments, and occasionally mining camps are established, and in spite of the depression in trade and the stringency in the money market there is a feeling that somehow the outlook is brightening in Ontario and that the process of education which has been carried on with more or less assiduity during the past four or five years concerning its mineral resources is producing its natural effect, even upon a people so slow to take up new and possibly hazardous enterprises as the Canadian moneyed men, with their $187,000,000 deposited in the banks. The merchants and manufacturers of Hamilton, with the courage and dash for which they are becoming noted, have had the satisfaction at last of seeing their iron furnace blown in and producing from native ores a pig iron of first rate quality. It is well nigh forty years since the last iron furnace in Ontario went out of blast, and during that long interval the iron mines of the country have been almost wholly idle. Indeed so little interest was felt in iron ores during this period that men had ceased to look for new deposits, and if discoveries were made it was more as a result of accident than of prospecting with intent. The requirements of the Hamilton furnace will no doubt lead explorers to take to the woods again, and old mines will be reopened, and roads and railways will be built to reach known deposits, and capital and labor will find employment in many directions in response to the requirements of this one new enterprise of the sturdy business men of Hamilton. The nickel and copper mines too are showing that they have a solid bottom. They are producing steadily, the demand for their metals is well maintained, and although reverses may be met with by some who undertake to work those mines, there is no fear but they will continue to give employment to men and money, as well as character and stability to mining operations in the country. Mining begets mining, and the industry established at Sudbury cannot fail to react upon like

Indications of progress in the mining industry.

The Hamilton blast furnace and the effect it is likely to have upon iron mining.

The nickel and copper mines.

undertakings elsewhere. The reputation of nickel as a metal valuable in the arts is growing every year, new uses are found for it, and with the cheapening of production as a result of the discovery of new processes for treating and refining the ore, it cannot be but more labor, more capital and more skill will be required in its production. And of this fact we have a pretty good assurance, viz., that the largest and richest deposits of nickel in the world are found to lie within an area of 2,000 square miles in the Province of Ontario, and in a region of easy access by water and rail. There may be richer and larger deposits elsewhere, possibly, but if so they remain to be discovered. Then there are the gold fields. The precious metal is found in the eastern part of the Province, in the county of Hastings, where mines were worked a quarter of a century or more ago, and where they are likely to be worked again and to greater advantage, with a knowledge of better methods for treating the ores and winning the metal. It is found in the middle northern part of the Province, in the same great Huronian belt which produces the ores of nickel and copper, where discoveries have been made of very bright promise, as around the shores of lake Wahnapitæ. It is found on the north shore of lake Superior—where is a discovery not yet a year old, and the large veins of rich quartz there are likely to yield bullion in good quantity before the present year is out. It is found too throughout an extensive region from Lac des Mille Lacs to the western shore of Lake of the Woods and from Rainy lake on the Minnesota boundary to Lonely lake on the Keewatin boundary, a tract of at least 2,000 and more probably 3,000 square miles. Here, on Lake of the Woods and along the Manitou and Wabigoon rivers, on Rainy lake and along the Seine river, most promising discoveries have been made within the last four or five years, and perhaps the best of them within the last four or five months, and already several mines are steadily worked and are producing gold with an outlay of capital which in other countries would strike the miner with astonishment. Many of the properties are easily reached by waterways; indeed the prospector has hardly yet at all ventured inland from the canoe routes, and in consequence there is little need of roads over which to take machinery or supplies. And of course there is no scarcity of that very essential element in milling gold ores, water. In Western Australia at the present time the Legislative Assembly is being asked by the Government to grant $12,500,000 to provide a water supply of 5,000,000 gallons daily to the Coolgardie gold fields. The whole area of this gold field of ours in north-western Ontario is a network of rivers and streams, with navigable lakes whose long arms stretch inland such distances as to give to comparatively small sheets of water like Lake of the Woods and Rainy lake a coast line as long as that of lake Erie or lake Ontario. The timber too is abundant for every purpose of the miner, under ground and above ground, for supports, for buildings and for fuel; and there are many gold fields elsewhere to which gold hunters flock where no timber is to be had for any purpose. In Western Australia wood for fuel costs $10 per cord. Moreover, the ore of this wide region is almost altogether free milling; so much so that with a stamp mill 80 to 90 per cent. of the contained gold may be taken off the plates. It is usual to speak of placer deposits as the poor man's field for mining, as he may with

Gold fields of Ontario.

Comparative advantages offered to investors and miners by the Ontario gold regions.

a pan or a rocker wash the gold out of the gravel. But with free milling ore which yields $10 to $20 or $30 per ton, and a mill of five or ten stamps which can be set up and fully equipped at a cost of $5,000 to $10,000, there is ample encouragement for a venture by the mining man who knows his business and is possessed of even modest means. Between such an enterprise and one which requires an outlay of $500,000 for a smelting plant, there is a contrast which ought to tell most favorably for the gold field of northwestern Ontario, and there is good reason for the hope that it is now beginning to do so. Already there are large investments of British and American capital, as well as of some Canadian capital, in properties on Lake of the Woods and along the Seine river, and in a few months at the outside enough work will probably have been done to make or mar the fortune of the district as a gold field. With four such valuable metals as iron, copper, nickel and gold being produced in the country, and with confidence that the ores of these metals exist in abounding quantities, there ought to be no doubt as to the future of our mining industry, however much it may be regretted that operations are not being carried on with greater activity and enterprise than is now apparent.

Future of the mining industry.

Sale and Lease of Mining Lands.

The following table presents the number of patents issued in the several districts of the Province last year for mining lands, together with the acreage of the locations and the price paid therefor to the Treasury :

Mining lands patented.

Districts.	No. of patents.	Acres.	$
Rainy River	74	4,856	10,011
Thunder Bay	6	1,829	3,688
Algoma	2	315	927
Nipissing	2	202	561
Elsewhere	15	518	681
Totals	99	7,720	15,868

Nearly two-thirds of the whole acreage and three-fourths of the number of patents are to the credit of Rainy River district, which embraces the gold regions of Lake of the Woods, Rainy lake and the Seine river. By far the greater part of this land was taken up for gold, and the increase of 3,153 acres in area and forty-five in the number of locations over the transactions of the previous year shows how rapidly the district is advancing in the favor of prospectors. In the Thunder Bay district most of the land was taken up for iron ore. The average area of patented locations last year was 65.62 acres, while in 1894 it was 58.71 acres. In the price paid there was an increase over 1894 of $8,222, or 107½ per cent.

The next table gives the number and acreage of mining lands leased during the year, by districts, together with the sums paid into the Treasury for the first year's rental:

Mining lands leased.

Districts.	No. of leases.	Acres.	$
Rainy River	160	13,790	13,790
Algoma	3	231	231
Nipissing	8	783	783
Elsewhere	4	280	120
Totals	175	15,084	14,924

The total number of leases issued is greater than in 1894 by 109, the area covered by them is greater by 8,033½ acres or 114 per cent. and the receipts from rentals greater by $8,436 or 130 per cent. It will be observed that all but fifteen locations were taken up in the Rainy River district, where the number of leases issued was 112 more than in the previous year and the area of land taken up greater by 8,521¼ acres. Of mining lands leased and patented, the total number of locations for which patents and leases were issued last year was 274, embracing a total area of 22,804 acres, being in excess of the transactions of 1894 by 168 in number and by 12,482½ acres in area.

The comparative statistics of the four years 1892-95 exhibited in the following table present at a glance the transactions in mining lands during that period:

Comparative statistics for the years 1892-5.

——	1895.	1894.	1893.	1892.
No. of locations sold	99	40	63	65
Area of locations sold......acres	7,720	3,271	4,370	6,200
Price of locations sold..........$	15,868.00	7,646.00	11,489.00	15,273 00
No. of locations leased	175	66	122	95
Area of locations leased ...acres	15,084	7,050½	13,046¾	13,122½
Rental of locations leased[1] ....$	18,211.16	10,296.56	14,669 76	12,917.36
Total number of locations	274	106	185	160
Total area of locations .....acres	22,804	10,321½	17,416¾	19,322½
Total revenue from locations ..$	34,079.16	17,942.56	26,158.76	28,190.36

The figures for 1891, the year in which the new mining law went into operation, are not given in this table because they embrace a very large number of sales carried out under the terms of the old law and are therefore not admissable for comparison. The popularity of the leasing system is shown by the much larger area of mining lands which have been leased than patented, the excess in the four years being 26,743 acres. The total area of mining lands leased since the system went into operation in 1891 is 53,302 acres, for which there has been paid into the Treasury rents to the amount of $60,980 84.

[1] Including rentals from lands leased in previous years.

Summary of Mineral Production.

Quantity and value of mineral production in 1895, with number of workmen employed and amount of wages paid for labor.

Product.	Quantity.	Value.	Employés.	Wages.
		$		$
Building stone, rubble, etc......	....	438,000	850	296,000
Cement, natural rock.....barrels	55,219	45,145	45	14,166
Cement, Portland........ "	58,699	114,332	129	46,000
Lime.... ....bushels	2,090,000	280,000	500	104,000
Drain tile.... ....number	14,330,000	157,000	2,126	364,000
Common brick .... "	126,245,000	705,000		
Pressed brick, plain...... "	15,253,370	115,695	183	69,442
Pressed brick, fancy...... "	2,312,497	24,075		
Roofing tile............. "	375,000	6,200		
Terra-cotta....................	... .	38,500		
Sewer pipe....................	....	133,159	99	38,308
Pottery	....	108,000	150	45,000
Gypsum........... ....tons	3,373	7,471	24	6,500
Calcined plaster, etc. ...... "	444	13,095		
Mica...................... "	25	2,900	16	2,210
Salt .... "	51,009	188,101	133	56,496
Nickel .... "	2,315¾	404,861	655	209,960
Copper.................... "	2,365½	160,913		
Gold.... .... oz.	3,030	50,281	237	56,234
Petroleum ......imperial gallons	....	....	.... ..	....
Illuminating oil. "	10,924,826	1,237,328	355	190,007
Lubricating oil. "	2,400,404	205,591		
All other oils... "	7,081,717	285,308		
Paraffin wax ...... .lb......	1,964,228	86,608		
Fuel product	....	79,589		
Natural gas ....M cubic feet	3,320,000	282,986	92	73,328
Totals	....	5,170,138	5,383	1,571,651

Building Materials.

The depression in business which has prevailed without interruption during the past four years has produced its natural effect upon the building trade, marked by a steady decrease in the demand for and the production of building materials. Evidence of the situation is found in the record of building operations in the city of Toronto. Permits granted show a value of \$4,388,900 in 1891, of \$3,921,755 in 1892, of \$1,361,850 in 1893, of \$1,020,225 in 1894 and of \$1,346,810 in 1895. A slight improvement is observable in the last year, but this is too recent to have had any effect on the production of building materials, and the statistics show a steady falling off.

The following table gives the value of building stone, rubble and other products of the quarry for the five years, together with the amount of wages paid for labor in each of the five years :

Building stone, rubble, etc.

Year.	Value.	Wages.
1891......................	\$1,000,000	\$520,000
1892....	880,000	730,000
1893......................	721,000	464,000
1894	554,370	336,700
1895.................. ...	438,000	296,000

For each of the last two years the value is only about one-half of the value for 1891, and in Toronto the values of building permits granted were less than one-third.

The next table, which gives for the same years the production of common brick in thousands, also shows a very large decrease, although not so marked as in the case of stone. The returns which have been received indicate that fully one-third of the brick-yards in the Province have been lying idle during the past year.

Production of brick and tile in the five years 1891-5.

Year.	Brick, No. of M.	Value.	Tile, No. of M.	Value.	Wages.
		$		$	$
1891	160,000	950,000	7,500	90,000	432,000
1892	175,000	980,000	10,000	100,000	445,000
1893	162,350	932,500	17,300	190,000	451,000
1894	131,500	690,000	25,000	280,000	388,000
1895	126,245	705,000	14,330	157,000	364,000

The same table gives the production and value of drain tile, and it is gratifying to find that the quantity has been largely increased. The farmers of Ontario have been making vigorous efforts to meet the competition which confronts them everywhere, and the drainage of the land is one of the most effective means for enabling them to get the surest and largest results as the fruit of their labor. The quantity of tile manufactured rose from 7,500,000 in 1891 to 25,000,000 in 1894, and while there was a drop of nearly 11,000,000 from 1894 to 1895 the quantity produced in the latter year was about double of the make in 1891.

Pressed brick, roofing tile and terra-cotta are given in the next table for five years:

Pressed brick, roofing tile and terra-cotta.

—	1895.	1894.	1893.	1892.	1891.
Number	17,940,867	25,456,000	21,634,000	22,048,000	13,617,909
Value	$184,550	$286,230	$217,373	$259,335	$156,699
Wages.......	69,442	95,400	80,686	88,865	58,000

The fine quality of pressed brick made in the country and its suitability for private and public buildings of the better class have combined to make for it a good market, and when the present depression has lifted it is almost certain that a very much larger quantity will be called for than has yet been produced in any one year. Indeed it is only seven or eight years ago since the first pressed brick was made in the Province. Previous to that all pressed brick used in the country was imported from the United States, and it was generally believed that we had not here any suitable clay for making the article. It is well known now that we have several grades of it, and an illimitable quantity, and that the quality of the brick and terra cotta made is of the very best.

The statistics of lime, another indispensable article for building purposes, is given in the following table for the five years 1891-5:

Comparative statistics of lime production for 1891-5.

Year.	Bushels.	Value.	Wages of labor.
		$	$
1891	2,350 000	300,000	116,000
1892	2,600,000	350,000	120,000
1893	2,700 000	364,000	122,500
1894	2,150,000	280,000	108,000
1895	2,090,000	280,000	104,000

These figures bear a close relation to those of stone and brick, and the returns made to the Bureau by owners of lime-kilns show, as in the case of brickyards, that a large proportion of them are idle for want of a demand for their product.

TRAP ROCK FOR STREET CONSTRUCTION.

Trap rock as material for street construction.

A business which is capable of great expansion was begun last summer by the Powell and Mitchell Trap Rock Company of Bruce Mines, Ontario, and Marquette, Michigan, in the quarrying and exporting of trap rock to be used in the construction of boulevards or streets, principally if not altogether so far in the city of Cleveland, Ohio. The quarries of this company are situated on some small islands on the north shore of lake Huron, south of the township of Johnson. Last year their product was taken from Poole island, about two miles southwest of the mouth of Portlock river and about one mile and three quarters southeast of Walker river. There are said to be about 100,000 tons of available rock on this island, while on Walker island the quantity is thought to be about 500,000 tons. At this latter place the company has in contemplation the erection of a dock for shipping purposes. Situated as the properties are on the deep waters of lake Huron, they enjoy the advantages which all-lake carriage and resulting cheap freight rates can give them The rock is loaded directly out of the quarries into the vessels which discharge it on the docks at Cleveland. It is used at the latter place in the construction of carriage drives or boulevards in connection with the park system of the city, where about two miles of road 30 feet wide were built of it by the Board of Park Commissioners in 1895. Though its use there has so far been confined to roads of this sort intended for light travel only, for which purpose it has given eminent satisfaction, there appears to be no reason why it should not prove equally well fitted for heavy traffic streets with necessary changes in the method of construction. In the Cleveland boulevards the Telford-Macadam system of building roads is adopted, a foundation of hard limestone equal in quality to Mahoning valley limestone, ten inches in thickness, being first laid down. The Park Commissioners' specifications require that these stones shall be 4 to 10 inches in width, 8 to 20 inches in length, and not less than 10 inches in depth. They are laid on their broadest edges lengthwise across the roadway, and are bound by inserting and driving down stone of proper size and shape to firmly wedge them in place. Upon this foundation is spread the macadam made of broken trap rock. For the bottom course the stone is required to be crushed to a size that

Quarries on Poole and Walker islands, in lake Huron.

Boulevards in Cleveland parks.

will pass through a screen with $2\frac{1}{4}$-inch round holes and will not pass through a screen with 1 inch round holes. This is spread upon the foundation to such a depth that when thoroughly rolled its surface is two inches below the finished grade of the street. Fine screenings, such as will pass through $\frac{1}{2}$-inch round holes, are then spread on in at least three layers, each layer thoroughly worked in by wetting and rolling. Upon this coarse screenings, by which is meant broken stone which will pass through a screen with 1-inch round holes but will not pass through $\frac{1}{2}$-inch round holes, are laid and spread to a depth sufficient to bring the surface half an inch below finished grade. Fine screenings and dust are then applied to bring the surface up to grade. As to the quality of the road thus made, Messrs. W. H. Ford & Co., 128 Champlain St., Cleveland, contractors for the work, speak as follows, under date of October 19th., 1895:

Quality of the road.

"We have about completed a boulevard for the Park Commissioners of this city in which we have used 12,500 gross tons of the trap brought from Poole island, Georgian bay. . . We consider that we have the best road in the world, and it has been so pronounced by the different interested people who have visited this city and inspected it. They were here from Chicago, Detroit, Youngstown and other places. Having made a visit to several places in the eastern States for the purpose of examining the roads built of trap rock and comparing them with ours, we have no hesitation in saying that the trap rock used here is harder, freer from quartz or vein matter found in other trap rocks, and therefore better suited for road beds.

This testimony is confirmed by Mr. F. C. Bangs, secretary of the Board of Park Commissioners, who says:

"We think we are building the finest road in America. Interested parties from Chicago and Pittsburgh have been here to see it, and expressed themselves as highly pleased with the same."

Cost of construction.

The total cost of building the roads, including foundations, gutters (for which Medina stone is used) and all other items of expense, was \$3.10, \$3.19 and \$3.65 per square yard respectively for three separate sections. The road is therefore not a cheap one as built in Cleveland, the cost being greater than a pavement of either vitrified brick or asphalt, according to the experience of the city of Toronto. A comparative statement of the cost of the three pavements is as follows:

Light asphalt, 4-in. concrete, 2-in. asphalt	\$2.10 per sq. yd.
Heavy asphalt, 6-in. concrete, $2\frac{1}{2}$-in. asphalt......	2.60 "
Vitrified brick, on 4-in. concrete	2.25 "
Trap rock, 10 in. Telford foundation, 8 inches broken rock	\$3.10 to \$3.65 "

Characteristics of trap rock.

The name "trap" has no reference to either the chemical composition or mode of origin of the rocks to which it is applied, but was originally bestowed upon those varieties, such as basalt, which present a step-like appearance or an outline composed of a succession of platforms one above another. It is sometimes loosely used to designate a series of rocks differing widely in character, but eruptive in origin, occurring in dykes or overflows, and consisting essentially of felspar together with such minerals as augite, hornblende and chlorite. This series of rocks furnishes good material for roadmaking which

is largely employed in England and the countries of continental Europe. Specimens of the rock quarried on Poole island were examined by Dr. Coleman, and are described by him as follows:

"One of them is dark green in color; the other has many reddish particles mixed with the green. They are rather coarse grained and massive. Examined microscopically, they prove to contain much the same constitution, badly weathered plagioclase felspar and augite largely changed to chlorite. Besides these minerals, quartz occurs in small masses or intergrown as pegmatite with the felspar, often about a felspar crystal as a nucleus. As accessory minerals one finds hornblende, magnetite and a little pyrite. The structure of the rock is between the ophitic and granitic, but more inclined toward the ophitic, so that the name quartz diabase is probably the most appropriate. In general, the somewhat obsolete term "trap" is applied to it. This rock probably occurs as large dykes or possibly as sheets representing an ancient volcanic outflow. It should prove as serviceable for road metal as the closely related melaphyres and basalts so much used in making the fine roads of southern Germany." Composition.

A solid cubic foot of the trap rock is said by the Powell and Mitchell Company to weigh 180 lb., while a cubic yard of the broken stone weighs 3,000 lb.

Some of our Ontario towns and cities may perhaps desire to emulate the example of Cleveland in the matter of well paved boulevards or drives, and if so, and their location is such as to admit of the transportation of the raw material by water, they are not likely to find a road covering of better quality than the trap or quartz diabase rock of which an immense supply exists in our own Province. On the north and northwest shores of lake Superior are areas thousands of square miles in extent whose overlying strata, as displayed in the summits of numerous hills, are composed of trappean rocks, the relics of volcanic action on a titanic scale in a long past age. The promontory of Thunder cape, the mass of McKay's mountain, the rocks of Pie island, the "Paps" on the east side of Black bay, are all composed of trap, as are also the formations on St. Ignace and Simpson's islands and about Point Porphyry. In some parts of the north shore the trappean rocks are of great thickness, having in places a depth of 6,000 to 10,000 feet. In its lower portions the overflow is usually massive and cystalline, but it becomes more amygdaloidal towards the top. From Pigeon river to the Kaministiquia, and from Thunder bay to Nipigon bay, the shore of lake Superior and the country to a considerable extent inland, including a large area north, west and south of lake Nipigon, exhibits this trap overflow in enormous development. Farther east, varieties of diabase or chloritic trap, says Dr. Chapman, "occur both in the form of dykes and intercalated bedded masses among the Huronian strata of lake Superior, as in Michipicoten island, as well as Gros Cap, Cape Mamainse, Point-aux-Mines, Goulais river and elsewhere.'[2] On the north shore of lake Huron trap is of common occurrence, and dykes of the variety known as greenstone are found in the Madoc and Marmora region, and also on the St. Lawrence river below Kingston. That the whole of this almost illimit- Supplies of trap in Ontario.

[2] Minerals and Geology of Ontario and Quebec, p. 189.

able store of rock would on trial prove suitable for road material cannot be affirmed, but there seems to be no reason why a large proportion of it should not. It can hardly be doubted that if trap rock came actively into demand, the Province of Ontario could furnish enough to cover all the streets of all the cities of North America for hundreds of years to come. Cheaper, because more accessible, materials are now employed in the construction of roads within our own land. The tough and durable trap when broken to proper size forms a much more lasting pavement than the soft limestone gravel of which our best country roads are now made, and if it could be supplied at low enough cost, its use would not be confined to cities and towns, but might also be extended to the prosperous and thickly settled agricultural parts of the Province, where easy travel and good roads are a prime necessity.

VITRIFIED BRICK FOR STREET PAVING.

The paving brick industry.

The immense development which the paving brick industry has undergone in the United States has made it very apparent that vitrified brick as paving material has "come to stay," and it is pleasing to record that the business has now fairly begun an existence in Ontario. The Ontario Paving Brick Company, of which Mr. A. E. Kemp is president, Mr. S. G. Beatty secretary-treasurer, and Mr. C. R. S. Dinnick manager, has erected a well-equipped factory for the manufacture of paving brick at Carlton, a short distance from the city limits of Toronto.

Factory at Carlton, near Toronto.

The plant.

The works are fitted up with a Penfield brick plant, including a wire-cut machine, automatic cut-off table and re-press of sixty tons pressure; the nominal capacity being 30,000 brick per day of ten hours, but equal to turning out if required at least one-third more. There are two dry pans with necessary screens, and one large pug mill The dryer, operated by artificial heat, has a capacity to dry 30,000 brick in twenty-four hours. Power is supplied by two large boilers and a Wheelock engine of 150 horse-power. The kilns are four in number, of the Eudaly down-draft type, and are capable of burning between 300,000 and 400,000 brick per month. Run-of-mine coal is used as fuel. About fifteen days is required to burn a kiln, and about ten days more to cool off. Mr. Dinnick, the manager, has very strong ideas on the proper method of burning vitrified brick, believing that they should be exposed to a temperature sufficiently high to frit together the clay of which they are composed, but that they should not be over-burned or made glassy by excessive vitrification. In addition to proper burning, slow cooling is essential to a first-class annealed brick. The whole plant of the Ontario Paving Brick Company is of the most modern and approved kind, and is modelled on the best American factories.

Supplies of clay and shale.

The company has a little over 100 acres of land at Carlton, twenty-two acres at Campbellville in Halton county, and about two acres on the Humber river. On the Carlton property the deposit of clay suitable for paving purposes is three feet six inches thick, extending over most of the area, and underlying this is a bed about three feet in thickness which answers well for ordinary building brick. A mixture of the red or Medina shale which is brought from

Campbellville with that found at Carlton is used as raw material for the paving brick, and the result is highly creditable to Mr. Dinnick's skill and the efficiency of his plant.

Uses of the brick in Toronto.

Last year the company supplied brick for paving Selby street and a portion of St. Patrick street in Toronto, in addition to a considerable quantity required for the crossings of various other streets. This year part of Prince Arthur avenue next to Avenue road is being paved with the company's brick, and it is expected that several other streets will also be covered with this material. The sorry condition into which so much of the cedar block pavement in Toronto has fallen will necessitate immediate renewal of many miles of streets, and it would certainly be in the public interest to pave with vitrified brick rather than to lay down the discredited blocks again. No American paving brick are now being imported to Toronto. The price of the Canadain article is $14 per thousand, which is much less than the cost of American brick with freight and duty added. The company employs eight to twelve teams, and thirty-five to fifty men.

The technical education of clay-workers.

Clay is the raw material for a great variety of finished products, ranging from common building brick to the finest of chinaware. Some of these products involve a great deal of skill in their manipulation, and clay is of all raw materials one of the most difficult to handle. Its complexity of composition and its liability to variation call for the utmost care on the part of manufacturers if an article of equable quality is to be maintained, particularly in the highest classes of goods, and it would seem therefore that in no branch of manufacturing industry would scientific knowledge and technical training be more useful or better welcomed. In Ontario as yet our clay deposits have not been called upon to furnish the more expensive products of ceramic art, and there has hitherto been probably small demand for the technically qualified engineer in clay; but even in the United States, where the clay industries have reached a high degree of expansion, facilities for the technical education of clayworkers have been strangely lacking. Indeed it was only in 1894 that the first attempt was made in that country to provide for the clay industries means of education similar to those which have long been enjoyed for instance by workers in metals or textile fabrics. In June, 1894, the University of Ohio opened a department of Ceramics and Clayworking, with Professor Edward Orton jr. at its head, and provision was made for thorough instruction in all the branches of engineering bearing on ceramics, and especially in physics and chemistry as applied to the treatment of clays. Two courses of tuition are open; one covering two years only, "is designed to assist young men who have already been actively engaged in the ceramic industries, and who on account of mature years, or lack of means, or lack of previous educational advantages, are unable to avail themselves of the full and complete course, and yet who wish to increase their earning power or chances of promotion by fitting themselves for other than manual labor." The other course extends over four years, and is the full equivalent in both quantity and quality of work required of any of the other engineering courses offered by the University. It leads to the

The Ohio School of Ceramics.

degree of Engineer of Mines in Ceramics. Special facilities are afforded for the study of clays, clay-working machinery and methods, and small kilns and furnaces are provided for laboratory work, as well as pyrometers, manometers, and apparatus for determining the plasticity and physical structure of clays. The example of Ohio is worth imitating by many of her sister States, whose clay industries are now important, and also by Ontario, where wealth of raw materials awaits the hand of the skilled manipulator to transform it into manufactured products fitted to serve the wants or minister to the tastes of man.

Gold, Nickel and Copper.

The following table presents for the four years 1892-5 the statistics of gold mining in the Province :

Gold in the years 1892-5.

—	1892.	1893.	1894.	1895.
Mines worked ....No.	9	15	4	8
Men employed above ground "	85	112	40	126
Men employed under ground "	40	56	52	111
Ore mined................tons	3,710	5,560	2,428	6,500
Gold product ....oz.	......	1,695	2,022½	3,030
Gold value ... ...$	36,900	32,960	32,776	50,281
Wages paid for labor ....$	22,750	49,027	38,032	56,234

It can hardly be said that this industry is yet on a stable basis, as far as the figures of the table show the situation. The gold product is to a very large extent to be credited to one mine; the other seven in 1895 were yet in the development stage, and the money paid as wages for labor had scarcely begun to be recouped in bullion. A much better showing would be presented if the statistics were given for the calendar year, instead of being for the year ending 31st October, and when the current year's returns are obtained it will probably be seen that the labor expended on development work has begun to get its reward. At two or three mines a quantity of rich ore was mined of which no account is taken in values, as the gold had not been extracted from it within the year. One of these mines computes its ore on the dump at a value of $16,000.

The production of mines yielding nickel and copper ore and the quantity of ore smelted in the four years 1892-5, ending 31st October each year, is presented in the following table :

Percentage of metallic contents in ore.

Year.	Ore raised, tons.	Ore smelted, tons.	Per cent. of metallic contents in ore smelted.		
			Nickel.	Copper.	Cobalt.
1892................	72,349	61,924	3.36	3.19	.1007
1893................	64,043	63,944	2.21	2.38	.0800
1894................	112,037	87,916	2.92	3.14	.0721
1895	75,439	86,546	2.67	2.73	.....

For nearly the whole of last year only the mines and works of the Canadian Copper Company were operated ; two of the other companies had closed

down owing to the death of the principal men in each, and a third company had suspended owing to financial troubles. Yet it will be noticed that the quantities of ore raised and smelted in 1895 were larger than in 1892 or 1893, and the quantity smelted was nearly as large as in 1894 when the furnaces of four companies were in blast. The percentage of nickel and copper in the ores varies considerably, but the difference is not so great as to be significant ; it was larger in 1895 than in 1893, though smaller than in 1892 and 1894, both of copper and nickel.

Comparative statistics of the industry are presented in the next table :

Comparative statistics for 1892-5.

—		1892.	1893.	1894.	1895.
Ore raised	tons	72,349	64,043	112,037	75,439
Ore smelted	"	61,924	63,944	87,916	86,546
Ordinary matte	"	6,278	7,176	10,410	12,525
Bessemerized matte	"	1,880	452	1,470	103½
Nickel contents	"	2,082	1,653	2,570½	2,315⅞
Copper contents	"	1,936	1,431	2,748	2,365⅓
Cobalt contents	"	8½	19	3¼	.....
Value of nickel	$	590,902	454,702	612,724	404,861
Value of copper	$	232,135	115,200	195,750	160,913
Value of cobalt	$	3,713	9,400	1,500	.....
Wages paid	$	339,821	252,516	311,719	209,960
Men employed		690	495	655	444

The metallic contents were larger very considerably than in 1892 or 1893, but smaller than in 1894. Values too show a depreciation, no doubt as a result of improved processes in extracting and refining the metals, but especially the nickel. With the cheapening of this metal new uses are sure to be found for it which must increase the demand, and it seems probable that for no other object is it so likely to be required as for the manufacture of nickel steel. One company of bicycle manufacturers in the United States used last year 400,000 lb. of nickel in the form of nickel steel alloy, which is nearly one-tenth of the total product of the Ontario mines.

The values in the foregoing table are based on the selling price of the matte at the works, and employing the same data the prices of the metallic contents for the four years 1892-5 per ton and per pound are found to be :

Average selling price per unit of metal contents at Sudbury.

Year.	Nickel.		Copper.		Cobalt.	
	per ton.	per lb.	per ton.	per lb.	per ton.	per lb.
	$	cents.	$	cents.	$	cents.
1892	283.81	14.190	119.90	5.995	436.82	21.841
1893	275.08	13.754	80.50	4.025	494.73	24.736
1894	238.36	11.918	71.23	3.561	461.54	23.077
1895	174.83	8.741	68.02	3.401	....	......

The fall in price of both nickel and copper has been constant from year to year, and corresponds closely with the market quotations of the refined metals in the London market.

The number of employés at the mines and works for the several years 1892-5, classified as workers above and below ground and according to the ages regulated by law, are presented in the following table:

Comparative statistics of workmen and wages, 1892-5.

Year.	Workers of 15 to 17 years		Workers over 17 years		Total workers.	Total wages.
	above ground.	under ground.	above ground.	under ground.		
						$
1892	10	....	483	197	690	339,821
1893	10	....	356	129	495	252,516
1894	17	....	395	243	655	311,719
1895	7	....	341	96	444	209 960

The average number employed last year was less than in either of the three preceding years as a natural consequence of the closing down of three of the works for the greater part of the year. The average wage earnings per man however was nearly the same as in former years, being a little higher than in 1894 and a little lower than in 1892 and 1893. The average value of product per man employed is pretty steadily gaining. In 1892 it was $1,197; in 1893, $1,170; in 1894, $1,236; and in 1895, $1,285; and this result appears alongside a steadily falling price for the product. The explanation of it is no doubt to be found in the greater economy of working the mines, made possible by the larger openings and the more general use of improved mining machinery.

Gypsum and Salt.

Statistics of the gypsum industry.

The total quantity of gypsum mined last year was 3,373 tons, valued at $7,471. By far the greater part of the raw material was used for land plaster but the manufacture of calcined plaster, alabastine, etc., is a more important industry. For these last named purposes 444 tons of gypsum was utilized last year, and the total value of the articles produced was $13,095. The industry in all its branches of mining, calcining, milling, etc., gave employment to 24 workmen, whose yearly earnings for wages are returned at $6,500.

Fourteen works were employed last year in the production of salt in the counties of Bruce, Huron, Middlesex, Lambton and Essex. The following table gives the statistics of the industry for the four years 1892-5:

Salt manufactured in 1891-5.

—	1895.	1894.	1893.	1892.
Tons made	51,009	35,215	48,350	43,387
Value $	188,101	115,551	149,850	162,700
Wages $	56,496	43,350	44,440	37,800

In quantity made, in value and in wages paid for labor, 1895 exceeds each one of the preceding three years. No attempt has yet been made to mine the salt, although beds of great thickness exist at a moderate depth, ranging from 900 to 1,300 feet; at all the works it is produced by evaporating the brine, which either flows from or is pumped out of the borings. Heretofore no other industry has been established in the Province in connection with salt works, but during the present year a plant is in course of construction for the manufacture of soda ash.

PETROLEUM AND NATURAL GAS.

It is difficult to procure statistics of the petroleum trade which can be accepted as perfectly reliable, inasmuch as the several independent sources of information differ somewhat widely in the figures they supply. Returns received by the Bureau from all the refineries show that the quantity of crude distilled in 1895 was 25,223,785 imperial gallons, and used for fuel 2,213,639 gallons, making a total of 27,437,424 gallons; and that the quantity of illuminating oil produced was 10,924,826 gallons. The monthly statement of railway shipments from Petrolea shows that the quantity of crude carried out was 232,282 barrels, or 8,129,870 gallons, and of refined 311,962 barrels, or 10,918,670 gallons, being a crude equivalent in all of 1,012,185 barrels, or 35,426,475 gallons. The Canada Statistical Abstract and Record, which claims to supply "the only trustworthy statistics of Canadian production of oil that are available," gives the quantity of refined oils inspected last year as 10,928,894 gallons,[3] or a calculated crude equivalent of 28,760,247 gallons, but not including the quantity of crude oil used as such. In this calculation a gallon of refined has a crude equivalent of 2.63 gallons, whereas in the shipments from Petrolea the equivalent is 2.50 gallons. But according to the returns made to the Bureau 2.31 gallons of crude produce a gallon of refined, on which basis the total of crude and refined shipped from Petrolea in the year would be 33,351,997 gallons instead of 35,426,475 gallons as shown by the monthly statements. The returns of the refineries made to the Bureau however give only the quantities of crude which were distilled and used as fuel, an aggregate of 27,437,424 gallons, and not the total product of wells during the year, or the quantities shipped by rail. It is certain also that the whole of the crude oil shipped from Petrolea was not refined elsewhere, as the two outside refineries which were operated during the year did not treat much more than 20 per cent. of it. The quantity of refined oils reported by the Canada Statistical Abstract and Record is very nearly the same as the Bureau's returns, being larger by 4,068 gallons or 116 barrels. The following table from the same authority gives the product of refined oils and their crude equivalent in imperial gallons for the ten years 1886-95:

Variable character of statistics of the oil industry.

Refined oils and the crude equivalent.

Production of refined oils in the ten years, 1886-95.

Year.	Refined oils.	Crude equivalent calculated.
1886	8,149,472	21,445,979
1887	8,243,962	21,694,637
1888	9,545,895	25,120,776
1889	9,462,834	24,902,195
1890	10,121,210	26,634,763
1891	10,270,827	27,028,492
1892	10,238,426	26,943,227
1893	10,683,806	28,115,278
1894	10,825,350	28,487,763
1895	10,928,894	28,760,247

[3] A letter to the Bureau of Mines from the Inland Revenue Department under date of February 25 says: "The total number of gallons of Canadian oil inspected in 1895, according to the books of this Department, was 10,674,232 gallons."

Percentages of products distilled from the crude.

For each of the above years the crude equivalent is calculated on the ratio of 1 to 2.63, which was probably correct enough for the earlier years; but with improvements in the process of refining, a larger proportion of illuminating oils is obtained from the crude now than formerly. The proof of this is furnished in the following table, which gives the percentages of the several products, except paraffin and fuel materials, obtained at the refineries in each of the four years 1892-4:

Product.	1895 p.c. of crude.	1894 p.c. of crude.	1893 p.c. of crude.	1892 p.c. of crude.
Illuminating oils	43.31	41.10	39.12	38.37
Lubricating oils	9.51	10.91	12.45	12.35
All other oils..........	28.075	30.45	28.14	27.34
Totals	80.895	82.46	79.71	78.36

Evidence of progress in modes of treatment.

In those four years the proportion of illuminating oils extracted from the crude has increased steadily each year, until in 1895 it was 4.64 per cent. more than in 1892. The proportion of lubricating oils has decreased 2.84 per cent., and that of all other oils has remained very nearly the same; but the average of all oils extracted from the crude has been raised by 2 53 per cent. At the same time the quality of the illuminating oils has been so much improved that they are now little if at all inferior to the best American. The quality of the crude remains as formerly, with its high percentage of sulphur.

Shipment statistics.

The statement which follows gives the monthly shipments of crude and refined oils by rail from Petrolea for the year 1895, and the totals calculated in crude equivalent at the ratio of 1 to 2½. The measure is in imperial barrels of 35 gallons per barrel.

Monthly shipments of crude and refined oils from Petrole rail in 1895.

Month.	Crude.	Refined.	Crude equivalent.
January..........................	21,155	27,323	89,462
February	18,810	25,875	83,497
March	17,380	19,825	66,943
April	15,400	17,955	60,287
May	18,165	18,382	64,120
June	15,670	17,725	59,982
July	18,985	17,370	62,410
August	17,335	24,335	78,173
September........................	20,772	32,615	102,309
October	24,970	46,727	141,787
November.........................	19,890	32,484	101,100
December	23,750	31,346	102,115
Totals........................	232,282	311,962	1,012,185

On the basis of 1 to 2.31, which is the ratio of refined to crude equivalent computed from last year's returns to the Bureau, the total of crude equivalent would be 952,914 barrels, or 33,351,997 gallons, and in reckoning the value of crude oil this estimate will be taken.

The following table gives the weekly market prices of crude at Petrolea and Oil Springs for 1895, and of refined in car lots, from which are deduced the averages for each month and for the year :

Market prices.

Weekly prices of crude and refined oils in 1895, and averages per month and for the year.

Month.	Petrolea crude.	Oil Springs crude.	Refined in car lots f. o. b. cents per gal. in bulk.	Refined in car lots f. o. b. cents per gal. in bbls.
	$ per bbl.	$ per bbl.		
Jannuary. 3	1.16½	1.17½	7	9¾
10	1.16½	1.17½	7	9¾
17	1.16½	1.17½	7	9¾
24	1.16½	1.17½	7	9¾
31	1.16½	1.17½	7	9¾
February. 7	1.16½	1.17½	7	9¾
14	1.16½	1.17½	7	9¾
21	1.20	1.22	7	9¾
28	1.25	1.27	7½	10¼-10½
March ... 7	1.25	1.27	7½	10¼-10½
14	1.26	1.28	7½	10¼
21	1.30	1.32	7½	10¼-10½
28	1.31½	1.33	7½	10¼-10½
April ... 4	1.34	1.36	7½	10¼-10½
11	1.36	1.38	7½	10¼-10½
18	1.55	1.57	12-12½	15
25	1.77½	1.79½	12-12½	15
May 2	1.75	1.77	12	15
9	1.60	1.62	12	15
16	1.60	1.62	12	15
23	1.50	1.52	12	15
30	1.50	1.52	12	15
June 6	1.50	1.52	12	15
13	1.50	1.52	12	15
20	1.50	1.52	12	15
27	1.50	1.52	12	15
July 4	1.50	1.52	12	15
11	1.50	1.52	12	15
18	1.50	1.52	12	15
25	1.50	1.52	12	15
August .. 1	1.52	1.54	9¾	12¼
8	1.52	1.54	9¾	12¼
15	1.53	1.55	9¾	12¼
22	1.53	1.55	9¾	12¼
29	1.53	1.55	9¾	12¼
September 5	1.53	1.55	9¾	12¼
12	1.53	1.55	9¾	12¼
19	1.53	1.55	9¾	12¼
26	1.55	1.57	9¾	12¼
October .. 3	1.55	1.57	9¾	12¼
10	1.55	1.57	9¾	12¼
17	1.55	1.57	9¾	12¼
24	1.55	1 57	9¾	12¼
31	1.55	1.57	9¾	12¼
November 7	1.58	1.60½	9¾	12¼
14	1.60	1.63	9¾	12½
21	1.68	1.71	9¾	12½
28	1.74	1.77	10	12¾
December 5	1.70	1.72	10	12¾-13
12	1.70	1.72	10	12¾-13
19	1.70	1.72	10	12¾-13
26	1.70	1.72	10	12¾ 13
Monthly averages :				
January	1.16½	1.17½	7	9¾
February	1.19½	1.21	7	10
March	1.28	1.30	7½	10⅓
April	1.50½	1.52½	10⅔	12
May	1.59	1.61	12	15
June	1.50	1.52	12	15
July	1.50	1.52	12	15
August	1.52½	1.54½	9¾	12¼
September	1.53½	1.55½	9¾	12¼
October	1.55	1.57	9¾	12¼
November	1 65	1.68	9¾	12¼
December	1.70	1.72	10	12⅞
Yearly averages	1.47⅓	1.49¼	9.8	12.5

The petroleum of the Oil Springs field is of a better quality than that of the Petrolea field, and is quoted usually at two cents per barrel higher. The yield however is so much less that in computing total values the average quotations for Petrolea crude may be taken. The quotations for refined oils are given for car lots, in the first column in bulk and in the second in barrels—the difference ranging from 2½ to 3 cents per gallon, and the average for the year 2.7 cents. The weekly quotations of crude and refined show an upward tendency throughout the year, the highest averages for the former being reached in November and December, and for the latter in May, June and July.

Production and values of crude oil in the five years 1891-5.

The following table gives the quantity of crude petroleum produced in the two fields for each of the five years 1891-5, and the value of it computed from the average prices for crude :

Year.	Imperial gals.	Value.	Value per gal.
		$	cents.
1891	31,312,645	1,209,558	3.863
1892	28,000,000	1,000,000	3.571
1893	34,055,000	1,099,868	3.230
1894	34,912,360	1,094,852	3.136
1895	33,351,997	1,403,960	4.209

Comparative values.

The crude product for 1895 is the estimate based on shipments and the ratio of 1 to 2.31. The value is computed from the yearly average of Petrolea quotations, viz.. $1.47⅓ per Imperial barrel, although in the returns made to the Bureau by refiners the average would be $1.57. Compared with the four preceding years, the average per gallon is seen to be decidedly better, ranging from a third of a cent per gallon in 1891 to a little more than one cent in 1894. The lowest point appears to have been touched in January of the latter year, when the price of crude was 92 cents per barrel. In August it rose to 95 cents, in September to 98 cents, and in October to $1.11¼. From the latter month to December of last year the price rose steadily until it reached the maximum of $1.70.

Products of refineries in 1895.

In the next table is given the statistics of products of the refineries for the year 1895 :

Product.	1895.	
	Quantity.	Value.
		$
Illuminating oils .... gal.	10,924,826	1,237,328
Lubricating oils .... "	2,400,404	205,591
All other oils .... "	7,081,717	285,308
Paraffin wax .... lb.	1,964,228	86,608
Fuel product	....	79,589

This table is compiled from returns sent in by all the refineries operating in the Province, and shows the products of 25,223,785 gallons of

crude oil treated during the year. The total value, including fuel product, was $1,894,424 ; the average number of workmen employed in the refineries was 355, and the amount of wages paid for labor $190,007.

On 30th September of last year, Mr. Noble informs me, the total number of wells in the Petrolea field was 6,787, and in the Oil Springs field 3,176, making a total of 9,963. Four years ago the number was only 5,088, whereof 3,535 were in Petrolea and 1,553 in Oil Springs. In several outlying fields a few wells have been bored during the past ten years, whose output is delivered at Petrolea. On the fourth concession of Euphemia, four miles northeast of Shetland village, about thirty wells have been drilled. Most of these were completed ten years ago, and one on John Fimby's farm yielded 20 to 30 barrels per day for a year ; it is now closed, having been flooded by water. On Richard Dobbyn's farm a well yielded 100 barrels per day for a few days only ; Mr. Dobbyn was offered $20,000 for it, which he refused. The present average yield of six producing wells in the locality is only one-half barrel per day. Two wells drilled in 1894 yielded for a short time 20 to 30 barrels per day. Five new wells were in course of being sunk in November last. In the southwestern corner of Plympton about a dozen wells exist, the product of which is pumped to Petrolea through pipe lines. In the old Bothwell field the good price of crude has led some enterprising men to undertake boring operations again, although the field has been abandoned for more than thirty years, and a hope is entertained that good flows may be struck at a depth of 1,400 to 1,600 feet. On Pelee island also several test wells have been drilled, and at two of these on the western side of the island oil was struck. The second one is on the farm of John Finlay, and on 9th March oil was reached at a depth of 750 feet, accompanied with gas. When the reservoir was struck the oil spurted out of the well to the height of the derrick, 35 feet, but the flow appears to have been intermittent. Other wells have been bored for oil and gas upon the mainland, near Leamington.

No. of producing wells,

and the several areas of production.

Euphemia.

Plympton.

Bothwell.

Pelee island.

The contract price for drilling wells in the Petrolea field is about $110, the oil being usually reached at 460 to 465 feet. Forty sets of tools were running last year in the territory, much greater activity having been shown since the price of crude has gone up. One rig, working in day time only, will complete a well in two weeks, and the average number of wells drilled is about 80 per month. About 100 wells are abandoned every year, but this is owing to local obstructions and not to failure of oil, it being found cheaper to drill a new well than to clean out an old one. In the early days of the industry many wells were abandoned which now would be regarded as first class yielders ; and as none of these wells were plugged the gas was allowed to escape freely, the result of which has been, in the opinion of some careful observers, a reduction of pressure upon the oil held in the the rock and a consequent falling off in the daily production. New wells will average 1 to $1\frac{1}{2}$ barrels per day for a month or six weeks, when they gradually fall off to a rate of 8 to 10 barrels per month. But there are exceptions. In July, 1873, Mr. W. K. Gibson drilled a well upon a five-acre lot on Durham creek, lot 14

Drilling new wells in the Petrolea field.

Production of the wells.

in the tenth concession of Enniskillen, which for a long time pumped 40 to 50 barrels per day, and after a period of two years he was shipping from it 900 barrels per month. In 1890, when Mr. Gibson sold the property, this well was producing 105 barrels per month, and he states that the present yield is 75 barrels per month. The Barnes wells, which occupy 48 acres of lot 9 in the fourteenth concession of Enniskillen, were bored in June, 1893, and began with a yield of 75 barrels per day. In May, 1895, the property was purchased by Mr. John Fraser, and he informs me that the yield of the two wells is now 550 barrels per month. It is Mr. Englehart's belief that if wells were bored down to reach the Trenton formation oil would be struck to rival that of the Ohio fields. In 1881 his company sunk one well to a depth of 1,505 feet, but abandoned the work before reaching the Trenton. Salt was struck at 1,087 feet, and the drill went through three or four beds until at 1,380 or 1,390 feet it reached one of pure solid salt, continuous to 1,505 feet without getting through it.

Stocks of crude oil.

Ten years ago it was the custom to hold in stock about 500,000 barrels of crude, for which purpose underground tanks were constructed 60 feet deep and 30 feet diameter, sunk in an impervious blue clay and lined with a wooden curb. Now the stocks are very light, not exceeding 50,000 barrels.

Imperial refinery works.

The Imperial refinery works, of which Mr. Englehart is manager, have a capacity to treat 750,000 barrels per annum. All grades of illuminating and lubricating oils are produced, as well as wax and grease. Improvements are made chiefly in lubricants, which are refined, re-distilled, reduced, filtered and pressed, to turn out various grades. By filtering through charcoal a grade of oil is obtained which is required for dynamo machines and other fine purposes. It has been demonstrated by tests at these works that Canadian oils thoroughly desulphurized give better light and burn longer than the best American. There are always some changes and improvements being made, Mr. Englehart informed me, but thoroughly desulphurized oils have been on the market for two or three years. Candles of all kinds are manufactured from paraffin, colored and white, compound, miners' composite, and many others according to use. Much of the oil product is shipped away in large boiler tanks, but much of it is also put up in barrels, and for this purpose the works require 50,000 to 60,000 barrels a year. Formerly these were made chiefly of oak, but as this timber is now growing scarce elm is being used in its stead and is made oil-tight by giving to it a double coating of glue. A smaller percentage of empties comes back now than was the case in past years, as many are being used as packing cases for the nickel and copper matte shipped from the smelting works at Sudbury.

National Oil Company's works.

The National Oil Company was organized two years ago to carry on the business formerly owned by Mr. John Macdonald, but Mr. Macdonald himself is president and manager, as well as the principal stockholder. There is only one well on the premises producing crude, but on Mr. Macdonald's farm two miles north of the works there are fifty wells whose product is delivered by pipe line to the refinery. The company buys 4,000 barrels of crude per week, which is the capacity of the works when running full time. They produce

illuminating and lubricating oils of different grades, paraffin wax, benzine, gasoline, etc., besides manufacturing candles and binding twine oil. The latter has got to be free from acids of all kinds, must not evaporate at under 250° F., and is required to contain 50 per cent. pure paraffin wax. The company claims that it is producing this quality, which is sold in tank car lots in Toronto at 11 cents per imperial gallon. "This oil is as good as if not better than the imported oils," Mr. Macdonald says, "yet at the Central Prison twine works the imported oil is used instead, on the pretence that it is freer from acids which would injure the fibre of the twine. This is not the case, for there is no question that the binding twine oil made at our works is perfectly free from acids." The company is now adopting steel barrels for shipping the products of the refinery, and a lot of 1,000 was in course of being made at the time of my visit to the works.

Fairbank, Rogers & Company's works

Fairbank, Rogers & Company was organized in 1892 as a partnership concern. The works are on the 12th line of Enniskillen, on the northern side of Petrolea, and at the terminus of the M. C. R. track. The firm is not directly interested in the production of crude oil excepting to the extent of a few wells on the property. But Mr. Fairbank is the largest producer in the country. He owns about 300 wells in different parts of the oil territory, including those of lot 18 in the second concession of Enniskillen—which is perhaps the best tract in the whole region. The works have a capacity to treat 2,000 barrels per week, and they produce illuminating and lubricating oils, gasoline, naptha and wax. The illuminating oils are of two grades, water white with a specific gravity of .786, and prime white .802. The lubricating oils are of various grades, among which are cylinder oils of superior quality for the use of railways, that until a year ago were supplied by American manufacturers. The total quantity consumed in the country is about 6,000 barrels per annum. Black oils are also shipped to India as grease for car axles. These oils formerly found a market in the United States, but are now excluded under a tariff which provides for free reciprocal trade; otherwise the duty is doubled. The paraffin wax is largely made up into candles, but is also used for other purposes. The whole product of this refinery is handled by Samuel Rogers & Co. of Toronto.

Petrolea Oil Company's works.

The refining works of the Petrolea Oil Company were established in 1872 by Messrs. Cochrane & Williams; but the principal owners now are Messrs. Charles Jenkins and John D. Noble, who are also largely interested in the Petrolea Crude Oil and Tanking Company. The refinery has a capacity of 100,000 barrels of crude a year, and produces gasoline, benzine and the illuminating and lubricating oils. The tar which produces wax is sold to the other refining works. Speaking of the relative merits of American and Canadian oils, Mr. Jenkins said: "The American crude produces a higher percentage of fine than the Canadian. Perhaps also it gives better light, but it burns faster. Our oil requires a higher draft to supply oxygen for the flame, and until recently lamps were not made for Canadian oils. But with a suitable lamp, such as the Excelsior, the Sun Hinge burner and the Climax burner, which give strong draft and high heat, a fine flame is produced. One gallon of Canadian oil will last as long as 1⅓ gallon of American. The Rochester lamp is a failure with our

Relative merits of Canadian and American oils.

oils. The old Sun burner too, so common in country places, is offensive in odor and smoke. What is wanted is a lamp that gives a good supply of oxygen to increase combustion."

NATURAL GAS.

Statistics of the natural gas industry.

The statistics of the natural gas industry for the three years 1893-5 are presented in the following table:

—	1895.	1894.	1893.
Producing wells .... No.	123	110	107
Gas product .... M cu. ft.	3,320,000	1,653,500	2,342,000
Value of gas ....$	282,986	204,179	238,200
Miles gas pipe	248	183½	117
Workmen ... .No.	92	99	59
Wages for labor ....$	73,328	53,130	24,592

The number of new wells bored during the year was 27, of which 19 were producing wells. These were fairly distributed between the Essex and Welland fields, but the non-producing wells were with one exception in the latter. The large increase in production took place in the Essex field, as a result of the laying down of a pipe line connecting the wells with Windsor, Walkerville and Detroit. Perfectly reliable figures of production however are not procurable; they are to a large extent estimates, and therefore it is hardly safe to venture upon comparisons, especially of product and value. In previous reports of the Bureau accounts were given of the principal companies operating in Welland county. The following account is now furnished of the largest company operating in the county of Essex, the details of which were obtained from the general superintendent in the month of November last.

The Natural Gas and Oil Company of Ontario, and its operations in Essex county.

The Natural Gas and Oil Company of Ontario grew out of the Ontario Natural Gas Company, which bored the pioneer well near Kingsville in 1888-9, striking gas January 29th of the latter year. The new company is really the old one with a new name, and has for its president Hiram Walker, for its managing director Dr. King, and for its general superintendent S. T. Copus, with head office at Walkerville. The total number of producing wells owned by the company (Nov. 22, 1895), is 14, located in the townships of Gosfield and Mersea, south of the second concession line of both townships. Their depth averages about 1,000 feet, the deepest being 1,050 and the shallowest 980 feet, varying according to the thickness of the surface drift. The gas producing region as far as proved has a width of two miles from the lake northward, by a length of twelve miles east and west. The total capacity of these wells is computed to be 60,000,000 cubic feet per day of 24 hours, but only a certain number of them are allowed to flow; indeed at this date only six are connected with the pipes, but others will be joined very shortly. Then the intention is to use groups of wells alternately. A pipe line of 8 inches diameter along the track of the Erie Railway was commenced in May, 1894, and on 1st August gas was delivered through it to Walkerville.

In September and October of the same year a pipe service was laid down in Windsor, and the total length of line from the field to Windsor is 35 miles. On 30th November connection was made with Detroit, where the gas is used chiefly for domestic heating and cooking purposes. In Windsor and Walkerville, where there are over a thousand services, it is used for steam-making in Walker's distillery, in breweries and salt works, and by the Electric Railway Company, the Electric Light Company and the city waterworks, and generally for domestic purposes, but not for lighting. A second pipe line was laid down last year and finished in October. It is a telescope pipe, one-half or a little more of its length being 8 inches and the second section 10 inches diameter. This has been laid down along the public highway, instead of along the railway track, and is consequently less liable to be jarred and broken by passing trains. It is also shorter than the first line by about five miles. A record is made every half hour of pressure at the field, as well as of temperature and of the force and direction of the wind, and this record is telegraphed in to the head office to be compared with a similar one kept there. From the time that the pipe line was opened it is stated that the rock pressure has been steadily maintained at 410 lb. per square inch.

Other companies operating in Essex.

The Essex Standard Oil Company has bored three wells in the same territory as the Natural Gas and Oil Company, but had not commenced to supply gas for consumption. Mr. Edward Harris of Kingsville is the manager. The Kingsville Gas Company supplies that village. A well in Leamington is owned by the corporation.

Surface gas wells in Kent and Elgin.

There are many surface wells in Kent and Elgin, especially in the townships of Harwich, Howard, Orford and Aldborough, but the supply of gas serves only for private use. In the northwestern part of Aldborough, near the limits of the old Bothwell oil field, there are 25 or 30 of those wells, which supply fuel to the farmers on whose lands they are.

NATURAL ROCK AND PORTLAND CEMENTS.

Statistics of the production of natural rock and Portland cements are given in the following table for the years 1894 and 1895:

Production of natural rock and Portland cements.

	Natural rock cement.		Portland cement.	
	1895.	1894.	1895.	1894.
Number of works	5	5	2	3
Number of workmen	45	63	129	105
Wages for labor	$14,166	$13,020	$46,000	$31,858
Product, bbl	55,219	55,323	58,699	30,580
Value	$45,145	$48,774	$114,332	$61,060

The production of natural rock cement remains nearly stationary, but the Portland variety shows a marked increase, the quantity having been nearly doubled although the number of establishments engaged in the manufacture of it was less by one. The great demand for Portland cement as material for street construction in the large cities, as well as for Government

works, has no doubt encouraged this industry at home; yet the quantity manufactured is only a small part of what is required. The following table shows how much the country requires above the home production, being the quantity and value of imports of Portland cement for home consumption for the eight fiscal years ending June 1895 :

Imports of Portland cement in the eight years 1886-7 to 1894-5.

Year.	Barrels.	Value.
1886-7	102,750	$148,054
1887-8	122,402	177,158
1888-9	122,273	179,406
1889-90	192,322	313,572
1890-1	183,728	304,648
1891-2	187,233	281,553
1892-3	229,492	316,179
1893-4	234,231	284,964
1894-5	196,281	242,813

This statement however does not include the Portland cement imported for the use of the Dominion Government, which under the provisions of the Customs Act is brought in free of duty.

Graphite in Brougham.

Discovery and development of graphite in Brougham township.

A large and apparently valuable deposit of graphite was brought to notice during the year, situated on the south side of Whitefish lake, on lot 18 in the third concession of the township of Brougham, in the county of Renfrew. The actual discovery was made some years ago, but at that time the deposit was thought to be of limited extent. Prospecting operations at a later date however made it apparent that the body of mineral was of very considerable size. So far as uncovered the vein or deposit has a length of 300 feet, and four cross-cuts made at intervals of 50 feet show a width respectively of 12, 17, 18 and 24 feet. Borings were made with the diamond drill at various points. One bore hole close to the edge of the lake passed through 39 feet of graphite; this was succeeded by 6½ feet of mixed limestone and graphite, and this again by 10 feet of graphite; 7 feet of limestone and graphite mixed followed, then 1½ feet graphite and 2 feet felspar and quartz. In another hole farther from the water 15 feet and 6 feet of graphite were separated by 7 feet of graphite and limestone. The deposit is not homogeneous, calcite occurring in nests and irregular masses, but containing also disseminated graphite and minute mica crystals. The quality of the mineral itself is somewhat lowered by the presence of this calcium carbonate, occasionally to such a degree as to render it useless. The lowest grade so far found contains 49 per cent. carbon, and the highest 85 per cent. An assay made by J. T. Donald, M.A., of Montreal, showed the following composition :

Occurrence and quality of the mineral.

Composition.

Graphite	84.12	per cent.
Silica	1.98	"
Alumina	1.56	"
Iron oxide	1.85	"
Lime	3.42	"
Magnesia	2.41	"
Carbonic acid	4 66	"
	100.00	

The graphite has a grayish aspect, is very hard, and occurs in a flaky and also in an amorphous condition. The deposit is veinlike in the manner of its occurrence, being embedded in gneiss, and striking in a northeast and southwest direction. Four hundred and seventy tons of the mineral have been mined and shipped to Ottawa, where a mill for its treatment is in course of erection. The lot was originally located to John Moore under the Free Grants Act, and on the discovery being made Moore took out the Crown patent of the mining rights of lots 17 and 18, containing 167 acres in all. Senator McKindsey of Milton interested himself in the matter, and a company has been formed to work the deposit and manufacture the graphite into crucibles, lubricators, polish, foundry facing, and whatever other products it may prove suitable for. The company is known as the Ontario Graphite Company, with head office at Ottawa, and the capital stock is $200,000. The chief officers are: S. H. Fleming, president, George A. Brophy, vice-president, and Hector McRae, secretary-treasurer. Mining and treating the graphite.

MICA BOILER AND PIPE COVERING.

The increased use of electric power during recent years has led to a largely increased demand for mica for insulating purposes, experience having shown that this mineral possesses the property of being impervious to the electric current in a very high degree. But the producers of mica have not found in the electric demand any relief from the state of affairs which was a continual source of loss to them before it began. Large sizes and good shapes of mica, such as are required for insulation purposes, were always marketable, but the difficulty still remained of disposing of the waste or scrap which forms so large a percentage of the output of mica mines and accumulates so rapidly at mica cutting works. Through the ingenuity of Mr. H. C. Micheli of Toronto this waste mica has now a value, though no doubt a small one as compared with that of the merchantable sizes. It is being utilized as material from which to manufacture coverings for boilers and steam pipes to prevent or lessen the loss of heat by radiation, mica being a good non-conductor of heat as well as of electricity. The scrap mica blocks are first put through a series of corrugating rolls which loosen the laminæ; these are finally separated from one another by air currents, after which the sheets are again put through a process which corrugates them singly. They are then laid between light galvanized wire netting, made into webs of a thickness suitable for the particular purpose they are intended to serve, and stitched with wire on a machine the first of its kind yet made. The flexible web of mica is covered with canvas stiffened at the back with millboard, and rounded into the desired shape. The covering when finished is fastened on the pipes by firmly lacing the edges together. Mica as a non-conductor of electricity and heat. Its new use as material for coverings of steam boilers and pipes.

The company is called the Mica Boiler Covering Company (Limited), Mr. Herbert C. Hammond being president, Mr. J. J. Kingsmill vice-president, and Mr. H. C. Michell managing director. The company's manufactory is at 9 Jordan street, Toronto, where it employs about twenty hands. Although in business Works of the Mica Boiler Covering Co.

only about a year, the demand for the company's output has risen so steadily that its present quarters are felt to be too cramped, and larger accommodation will soon be necessary.

Results of tests of the mica covering.

The scrap mica, of which about a ton per day is used, is procured mainly from the Ottawa district of the Province, and the company pays for it at the rate of about $5 per ton on the spot, or about $7.50 per ton delivered. The amber variety is preferred, on account of its more perfect cleavage. The company's product comprises all sizes of steam pipe covering from one-half inch in diameter upwards, and coverings for locomotive and marine boilers. Tests made on various occasions have, it is stated, shown its superiority in checking the radiation of heat to any of the other coverings commonly used for this purpose. A competitive trial made by the Canadian Pacific Railway in April of the present year gave really remarkable results in favor of the mica covering. An iron tank covered with it $1\frac{1}{2}$ inches thick was filled with water, which was raised to the boiling point and the fire withdrawn. For between 15 and 20 minutes the water continued to boil; at the end of the first hour the temperature had fallen to 210°; at the end of the second hour to 206°; at the end of the third hour to 202°; at the end of the fourth hour to 197°; at the end of the fifth hour to 192°; at the end of the sixth hour to 187°, and at the end of the seventh hour to 181°. The water in an uncovered tank was four degrees cooler at the end of an hour and a half than that in the mica-covered tank at the end of the seventh hour. Tests made by the Boiler Inspection and Insurance Company of Canada also showed not only that the mica covering effected great saving in weight of coal used and quantity of water evaporated, but that in the opinion of Mr. G. C. Robb, the company's engineer, it was "the most effective and convenient boiler covering on the market." Several large buildings in Toronto have been fitted up with this covering; among them the new dental college on Avenue street, and the R. Simpson company's large new store on the corner of Yonge and Queen streets. The Niagara River Navigation Company's newly launched steamer, the Corona, is also equipped with the mica covering on her boilers and pipes.

Carbide of Calcium.

Potentialities of the carbide of calcium.

Probably no discovery or invention of recent years—excepting, perhaps, that of the Roentgen rays—has excited greater or more widespread interest in the world of economics than the process of manufacturing calcium carbide hit upon by T. L. Willson, an account of which was given in the Report of the Bureau of Mines for 1894. As the raw material from which, by the mere contact with water, acetylene gas is evolved, calcium carbide places at the service of the user of illuminants a gas whose combustion gives a light twelve to fifteen times as brilliant as that of ordinary coal gas, and therefore an article of which a correspondingly smaller quantity is required to produce an equal effect. As the basis of a whole host of compounds of commercial importance, calcium carbide is perhaps of even greater potential value than as an illuminating agent. In this remarkable union of two such common materials as lime and carbon, indeed, lie probabilities and possibilities which may well bewilder

even the adept in physical science, familiar though he be with the processes by which the forces of nature are made to serve the interests of man. A recent writer in The Electrical Engineer summarizes as follows the capabilities of acetylene gas:

Acetylene and its surprising transformations.

" Acetylene, on being passed through an iron tube heated to dull redness, goes rapidly and completely into benzine, without the formation of any other product. Benzine is a product of prime importance, and is the base of thousands of organic substances, known as the benzine series of compounds. If the resulting benzine vapour be passed into strong nitric acid, it is transformed into the oily nitro-benzine, and this on treatment with hydrochloric acid and iron filings goes easily into aniline. The ton of calcium carbide, or the 812 pounds of acetylene, results thus in somewhat less than 956 pounds of aniline. With the formation of aniline the road is now clear for the production of the innumerable dye substances whose varied hues have adorned the sisters and wives of the last twenty years, and whose discovery and preparation absorb the energies of an army of chemists. Instead of passing into the dye substances however we may transform our aniline into carbolic acid. Thence it is but a step to picric acid, the foundation substance of many modern explosives. Or, again, we may boil the aniline with acetic acid, and we have transformed it into acetanilide, or anti-febrin, the well-known fever specific. These substances, with their varied properties, come thus primarily from a lump of coal and a piece of lime. Our protean acetylene however is capable of undergoing other changes just as startling. For instance, if it be passed through a tube heated to bright redness, it is changed to naphthalene, and naphthalene again will pass into a multitude of other valuable products. Or again, starting with acetylene, by the action of nascent hydrogen we may change it into ethylene, and finally into ethane. Ethylene, on being boiled with sulphuric acid and water successively, passes into alcohol, which is absolutely necessary to the production of an enormous number of economic substances. Ethylene, on treatment with permanganate of potash, readily oxidizes, first into oxalic acid and then into formic acid. If the formic acid so obtained be treated with ammonia, and the resulting product heated to 180° C, it is transformed into the deadly prussic acid. Acetylene in the mere presence of salts of mercury unites readily with the elements of water to form aldehyde, so much used today in the production of essences and the manufacture of mirrors. Starting with acetylene, by the agency of such cheap commercial products as muriatic acid, sulphuric acid, potash, ammonia and a few others, it is possible to build up whole systems of dyes, medicines, essences, perfumes, poisons and explosives. The methods by which this may be accomplished are known matters of pure chemistry. They become commercially and economically practicable with the cheap synthesis of acetylene." [4]

Economic production of acetylene.

This is an account of what is possible, rather than of what is immediately attainable. The keystone to the usefulness of acetylene is its economic production. In view of the many and important ends which it is capable of

[4] Article by R. K. Duncan, quoted in Industries and Iron, 30th August, 1895, p. 163.

serving, the manufacture of calcium carbide at a cost sufficiently low to permit of its being utilized in a commercial way is a matter of first-rate interest. The expense of producing the article has been a matter of much discussion, and on this point really hinges, for the present at any rate, the prospect of its speedy employment either in the production of light or of substances useful in the arts.

The principal, if not the only, works for the manufacture of carbide on the continent of Europe are situated at Neuhausen, in Switzerland, and it is stated that the cost of production there is $3\frac{1}{2}$ cents per pound, or $70 per ton of 2,000 pounds.[5] At the Falls of Foyers, in the Highlands of Scotland, a cascade whose beauties have been immortalized by the genius of Burns, calcium carbide is now being produced on a commercial scale under Mr. T. L. Willson's patents. In America the pioneer place of manufacture is Spray, North Carolina, where works were erected to test the practicability of the Willson method.

COST OF PRODUCTION.

The experimental works at Spray, N.C.

Widely differing estimates of the cost of production at Spray have at various times been put forward, and it has been contended by some that the expense involved was so great as to preclude the possibility of making use of the carbide for practical purposes. An interesting contribution to the information on this point was made by a report in Progressive Age, a journal published at New York and devoted to the interests of gas, electricity and water. In March of the present year a commission, composed of Dr. Edwin J. Houston, of electric lighting fame, Dr. A. E Kennelly, an electric engineer, and Dr. L. P. Kinnicutt, chief of the department of chemistry at the Worcester Polytechnic Institute, was sent by the proprietors of the periodical above named to examine and report upon the process of manufacturing the carbide carried on at Spray. As this process is practically the one adopted in the production of carbide by the Willson method elsewhere since the construction of the plant at Spray, it is deemed advisable to condense the description given by the commissioners in their report (April 15, 1896), and to state their conclusions as to the cost of manufacture, as follows :

The plant.

The plant consists essentially of a pair of electric furnaces for producing the carbide, electric generators for supplying the current, a turbine for driving the electric generators, and suitable apparatus for pulverizing and mixing the coke and lime required to charge the furnace. The power is furnished by a horizontal twin Leffel turbine wheel 30 inches in diameter, rated as capable, under 28 feet fall, of producing 300 horse power at 206 revolutions per minute and three-quarters gate opening. The water wheel is belted directly by tandem belts to two Thomson-Houston alternators, capable of generating a current of 240 kilowatts, or 321.8 horse power. There are two open electric furnaces placed side by side, each having a floor space of 3 feet by 2 feet 6 inches, and a height of about 8 feet. At the base of these is a

[5] Communication in Engineering and Mining News (New York), January 11, 1896, p. 35.

heavy iron plate supporting two carbon plates, one in each furnace, which in connection with the iron bed plate form the lower electrodes. The upper electrode for each furnace is a heavy carbon block 12 by 8 inches in cross section and 36 inches long, protected by a casing of sheet iron. It is clamped vertically in a metal holder supported by a vertical copper rod, passing through the roof of the furnace and connecting over a pulley with a hand wheel operated by an attendant.

Raw materials and the process of conversion in the furnace.

The raw materials, lime and coke, are crushed, ground and thoroughly mixed, the theoretical proportions being 60.87 by weight of lime and 39.13 per cent of carbon. They are taken from the mixer to the furnace, and the charge is started by throwing in a few shovelfuls upon the furnace floor, and establishing the arc through it between the upper and lower electrodes. At first the pressure and current at the furnace terminals are very irregular, but after the first quarter of an hour they become moderately steady, at about 1,600 amperes and 100 volts respectively. Under the action of the arc, which is usually about three inches long, the mixture immediately under the surface of the upper electrode is gradually converted into molten calcium carbide. The carbide tends to fill up the space between the electrodes, so that the upper electrode has to be raised to maintain the arc, thus allowing the new mixture to fall in from the sides. Fresh mixture is shovelled into the furnaces from time to time. Flames of ignited carbonic oxide, colored by the volatilization of calcium, rise from the surface round the upper electrode, but are smothered as far as possible by stoking and packing. The switchboard attendant continues to raise the upper carbon electrode by hand wheel, screw and chain, according to the indications of the voltmeters and ammeters, until the electrode has been lifted through its full range of about 30 inches. The addition of new mixture is then stopped, and the current is maintained until the last portions added have been sufficiently acted upon. The current is then cut off and directed into the neighboring furnace, which is operated while the first cools down sufficiently to permit of the withdrawal of the carbide in the solid form. The mass of carbide has roughly the form of a vertical prism of rectangular cross section, slightly tapering towards the top. Its surface is coated with a slag containing carbon, calcium oxide, calcium carbonate and calcium carbide. Below this surface is the mass of carbide, which remains fluid in its interior for many hours after the cessation of the electric current. In the two experimental runs made by the commissioners, the slag constituted about 5 per cent. in weight of the gross product, leaving the net result about ninety-five per cent. of the whole. The quantity of mixture unconverted into carbide varies from 50 to 75 per cent. of the charge. This is removed, and can be employed in the next charge.

Cost and capacity of the plant, and cost of producing carbide

The works at Spray are experimental in their character, and are not adapted to the production of calcium carbide on the most economical scale. The cost of the plant is given at about $11,955, of which $6,000 is for the electric machinery. The capacity of the works is 2,000 pounds gross carbide in

one day of twenty-four hours, and the cost of production is estimated a
$32.767 per ton, made up as follows:

Materials per day and per ton of gross carbide	$14.39
Labor " " "	11.00
Water power, $1,129\frac{5}{365}$	3.37
Petty stores, waste etc., $150 per annum	0.41
Taxes at $100 per annum	0.274
Interest on investment at 5 per cent, $11,955	1.638
Depreciation and repairs:	
Five per cent. on electric plant and turbine	1.218
Six per cent. on countershafting, building, rolls and crusher	.446
Twenty per cent. on furnaces	.021
	$32.767

Cost for water-power.

The cost of the waterpower is put at the low figure of $5 per horse power year at the turbine shaft. Taking the efficiency of the alternators as 88 per cent., and of the transformers as 95 per cent., the net efficiency of the electric plant is 83.6 per cent., making the cost of the electric horse-power at the furnace terminals $5.98. The mean power employed at the switchboard being 203.2 horse-power, that generated at the turbine shaft is 230.9 horse-power. Adding for the power supplied to crusher, mixer and shafting, 15 horse-power, the total power at the turbine shaft is 245.9 horse-power, for which the annual cost is $1,229.50.

Cost of materials.

Coke from the Pocahontas mines, Virginia, costs $1.50 per ton f. o. b., and delivered $4.55 per ton. Lime, also from Virginia, costs about $1.75 per ton f. o. b.; delivered, $6.30 per ton. About 2,250 pounds of coke and 2,670 pounds of lime are required for a ton (2,000 pounds) of gross carbide. Carbon for electrodes costs six cents per pound.

Yield of gas in the carbide.

The net carbide in the tests made by Messrs. Houston, Kennelly and Kinnicutt yielded an average of 4.926 cubic feet, and the gross carbide an average of 4.696 feet of moist acetylene gas per pound. As the theoretical product of one pound of calcium carbide in moist acetylene gas is approximately six cubic feet, the net carbide yielded only 82.1 per cent., and the gross carbide 78.26 per cent. of the possible product. The gas however was practically pure.

Estimated cost of calcium carbide under ideal conditions.

In a supplementary report Messrs. Houston and Kennelly estimate that in a perfect electric furnace under ideal working conditions, and on the assumption that coke can be laid down at $2.75 per ton and lime at $2.50 per ton, and that water power can be procured at $5 per horse-power per year, the cost of calcium carbide would be $8.734 per short ton. Owing to impurity of materials, departure from perfection in plant, etc., at the Spray works, the actual cost of material and power at the foregoing values, irrespective of electrode carbons, labor, depreciation, interest and other fixed charges, was $14.97 per short gross ton. Under favorable circumstances, such as they believe can be realized in particular localities, the total cost per short gross ton in a plant whose daily output is five tons might be $20.

PLANTS IN NEW YORK STATE AND MICHIGAN.

Plants for production of the carbide in America have been put up at Niagara Falls, N.Y., and at Lockport in the same State. At the former place the Acetylene Light, Heat and Power Company of Philadelphia have built a factory on the bank of the Niagara river, and the power required in the process of manufacture is obtained through the Niagara Falls Power Company from the great falls themselves. Four electric furnaces have a capacity of five tons of calcium carbide per day, and have been turning out this quantity since about the middle of Jnly, 1896. The lime is obtained from Port Colborne, Ontario, where are situated John Reeb's kilns, using natural gas for fuel, and also from the American side of the river. The coke comes from Pennsylvania. The process of manufacture does not differ in principle from that already described, but cast-iron crucibles are used to contain the charge in the furnace. These are saved from fusion by the charge itself, which receives the heat of the electric arc and which constitutes an excellent non-conductor. The product is all marketed in Philadelphia, where it is used wholly for lighting purposes. In the office of the company, lighted by acetylene, is a generator for converting the carbide into gas, called Naphey's Automatic Gas Generator, which appears well adapted for the purpose. It occupies little space, costs but a small sum, and entails almost no expense for attendance or maintenance beyond supplying it from time to time with the necessary water and carbide. Water is admitted to the chamber containing the carbide, and acetylene gas is immediately given off. When this has acquired a certain volume, it begins to force the water out of the chamber into a receptacle above, and the production of gas ceases. Upon the pressure of gas being lowered by its consumption, the water again makes its entrance and comes in contact with the carbide, and fresh gas is generated. In this way the production of gas is governed automatically by the quantity used. It is stated that this small piece of apparatus, costing perhaps $200, will take the place and do the work of an electric lighting plant valued at about $8,000. One such generator is capable of producing gas sufficient to light a large hotel or office building.

Plant at Niagara Falls, N.Y.

Works are also under way at the present time at Sault Ste. Marie, Michigan, for the manufacture of carbide to be supplied to the Chicago Gas Company. The elecric current will be generated on the Canadian side by the Lake Superior Power Company, which controls the immense water power afforded by the steep descent of the St. Mary river, the outlet of Lake Superior, and will be conducted across the river by a wire or cable.

Plant at Sault Ste. Marie.

PLANT AT MERRITTON, ON THE WELLAND CANAL.

In Canada the manufacture of the article is in the hands of the inventor, Mr. T. L. Willson himself, who has already entered into the work of production with characteristic energy. In this Province, Mr. Willson contends, are combined the facilities for making calcium carbide unequalled elsewhere in America, or indeed in the world. Great water powers, by means of which the required energy can be cheaply produced, vast beds of limestone of

Plant at Merritton, Ontario.

excellent quality, easily converted into lime, and good shipping facilities both by rail and boat, are three of the indispensable elements necessary to the building up of a great trade in this article, and Ontario has them all. The fourth element, an abundant and cheap supply of carbon, is not present in so marked a degree, owing to the fact that there are no coal mines in Ontario; yet the distance from the coke regions of Pennsylvania is not so great as to unduly enhance the cost of coke, upon which there is no import duty and which can be laid down as cheaply at Ontario points as at other places equally distant from the coal fields, which yet do not offer the other advantages to anything like the same extent. It is true that coke is not the only form of carbon which can be used in the production of carbide of calcium. Wood charcoal would perhaps be even preferable, on account of its freedom from the impurities which are found in coal and coke, but so far its comparatively high price has rendered its use impracticable.

Facilities for economic production here.

Wood charcoal a raw material of good promise.

The vast amount of material annually going to waste in the sawmilling and other wooden industries of Ontario ought to afford an ample opportunity for the production of charcoal on an economic scale, especially by the distillation method, by means of which the bye-products, such as wood alcohol, tar, etc., are saved, and greatly reduce the cost of the process. The Rathbun Company of Deseronto have shown that it is both practical and profitable to do this, and other large manufacturers and sawmillers might with advantage take a leaf from their book.

The natural resources, waterpower and lime, and facilities of transport, are found in a peculiar degree in the Niagara peninsula of Ontario. Niagara Falls, being a railroad centre and distributing point, also offers facilities for delivery of coke at minimum cost, either there or at other places in the peninsula. The difference in level between the waters of lake Erie and lake Ontario makes available the enormous power latent in the falling of the whole surplus water of the great lake system through a distance of about 325 feet. At the cataract of Niagara the great leap given by this body of water impresses the beholder with the resistless energy it possesses. But the Falls are not more than 160 feet high, just about one-half the total descent, the remainder being made by the river, partly above and partly below the cataract. On the American side of the river the Niagara Falls Power Company has constructed a large and costly plant, by means of which about 100,000 horse power may be developed, or one-half the force which they may legally derive from the Falls. The same company has acquired the right to develop 200,000 horsepower on the Canadian side, at a rental of $25,000 a year, but so far no steps have been taken to give effect to their privileges. There is the same descent in the Welland canal as there is in the Niagara river, but it is accomplished in gentler stages.

Water power of the Niagara river and Welland canal.

At Merritton, on the route of the old canal, Mr. T. L. Willson has acquired the power at locks Nos. 10, 9 and 8, giving a fall of 12 feet 8 inches, 12 feet 6 inches and 12 feet 2 inches respectively, and yielding a total of 1,650 horse power. Works are at this moment nearing completion for the

Willson's plant on the old canal.

manufacture of calcium carbide.[6] Mr. Willson purchased a flour mill known as the Downie mill, which stood for many years at lock No. 10, on the east bank of the canal, and has adopted part of the milling machinery for the preliminary processes of treating the lime and coke. Both materials are required to be reduced to a fine powder, but the coke must be ground finer even than the lime. For the lime a "pot" crusher gives the first reduction, and about one-third of the material is brought by this operation at once to the necessary fineness, the remainder being sent on to a pair of millstones, where it is also ground sufficiently small. The coke is reduced by successive pairs of corrugated rolls of graduated fineness, from each of which the product passes through a "scalper" or "grader," which sifts out the particles brought down to the required size, and returns the coarser ones to the next pair of rolls, the final operation being performed by a pair of smooth rolls. The whole process of grinding the coke answers almost exactly to that of making flour by the roller method, and is performed on machinery designed for this work. The lime and coke, when sufficiently crushed, are elevated to bins, whence they are emptied into a weighing hopper, and mixed in the proportions of about 100 lb. of lime (anhydrous) to 60 lb. of coke. Below the weighing hopper is a revolving cylinder in which the materials are thoroughly and intimately mingled, after which the mixture is stored in bins ready to be conveyed to the furnace room. Here is a series of electric furnaces, constructed in pairs. Each furnace requires about 250 horsepower for its operation, a pair thus consuming about 500 horsepower when worked continuously. It has been found advantageous to run only one furnace of each pair at a time, so that when 250 horsepower is being used a pair of furnaces can be in constant operation alternately, time being required to withdraw a fused charge and introduce a new one. The furnaces are the same in principle as those at Spray already described, but with improvements in detail, and capable of reducing a greater proportion of the charge to calcium carbide. When the aggregate power of the three falls is utilized, there will be six sets of furnaces, requiring 1,500 horsepower, and capable of producing 7½ tons of calcium carbide in 24 hours.

In the furnace room.

The power plant.

The power plant consists of two Leffel twin horizontal turbine water wheels of the type known as the "Samson" at each fall, each wheel capable of generating 275 horsepower under 12 feet head with full gate and running at 120 revolutions per minute. The turbines are immersed in a substantial wooden penstock behind massive masonry built to ensure the safety of the canal bank pierced for the water flumes, which are 18 feet wide and contain a depth of 7½ feet of water. The wheels are run separately, not in tandem. Each is connected by a belt 28 inches wide with a dynamo having a capacity of 75 volts and 2,500 amperes; consequently when the plant is complete there will be six water wheels each driving a dynamo, and furnishing a total of say 1,500 electrical horsepower.

[6]Just as this Report is going to press Mr. Willson writes under date of August 15th: "We successfully started up the work this morning and have been running at this moment of writing over four hours, producing carbide. Everything works splendidly for a new plant, and I am very much pleased to announce to you so successful an opening of what promises to become, in the future, Canada's greatest industry."

The current generated by the falls at locks number 9 and 8 will be conducted by wire to the furnaces in the present building, and by connecting the terminals the whole of the electric power can be evenly and automatically distributed among the furnaces just as it is required. The belts connecting the water wheels with the dynamos are of novel construction, being made of laced rawhide tanned in a manner to resist the action of water. They are manufactured in St. Catharines under the patents of Mr. Ellis, superintendent of the Riordan paper mill.

Transportation facilities.

A spur of the Niagara Central Railway runs to the door of the factory, giving good facilities for bringing in the raw materials and shipping the finished product.

Relative values of coal gas and acetylene considered.

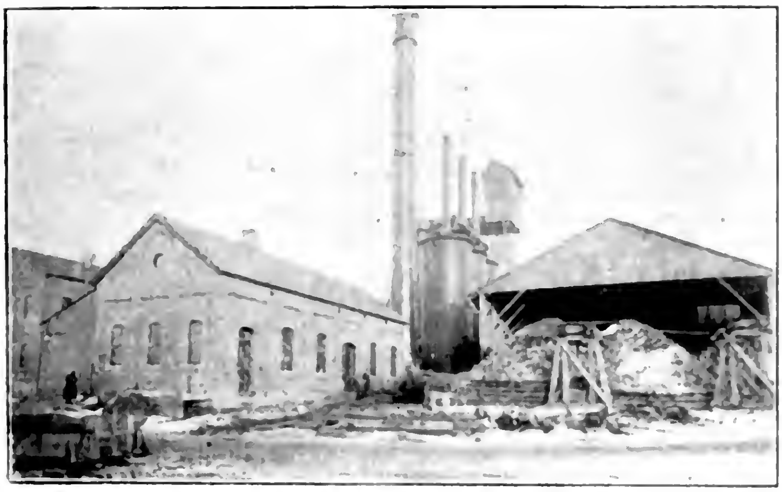
Mr. Willson, naturally enough, is an enthusiast on the subject of calcium carbide, and foresees an unlimited demand and a future of immense importance for it. A pound of the carbide will yield about 5 cubic feet of acetylene; consequently a ton will give off 10,000 feet. The illuminating power of acetylene being say 14 times as great as that of either Hamilton or Toronto gas, the product of a ton of the carbide is equal to 140,000 cubic feet of the gas produced in either of these cities. In Toronto the price of gas is now 90 cents per 1,000 feet, so that calcium carbide at $80 per ton is equal to gas at 57 cents per 1,000 feet. But Mr. Willson contends that the diffusive power of acetylene is much greater than is shown by the photometer, and that in practice a much less quantity is required than the theoretical equivalent, consequently the actual cost of the acetylene would be still smaller in comparison with that of gas. Arrangements are being made for a practical test of the merits of acetylene as an "enricher" of coal gas in the city mains of St. Catharines.

At the present stage of its development the illuminating properties of acetylene gas are engaging the attention of those interested in it almost exclusively, but the possibilities of its employment in synthetic chemistry in a commercial way will receive closer investigation when it has been a little longer in the market. Mr. Willson is advertising the carbide for sale at present for $80 a ton, ready barrelled for shipment, and at this figure he believes it absolutely certain to have a large local demand. The export trade to Europe will be a considerable feature of his business, and large contracts are offered him from Belgium and elsewhere. He confidently expects to be able to sell the carbide profitably in Europe at a lower cost than that at which the manufacturers there can produce it. For cooking and heating purposes also there is a wide field of usefulness open to this article so varied in its capabilities.

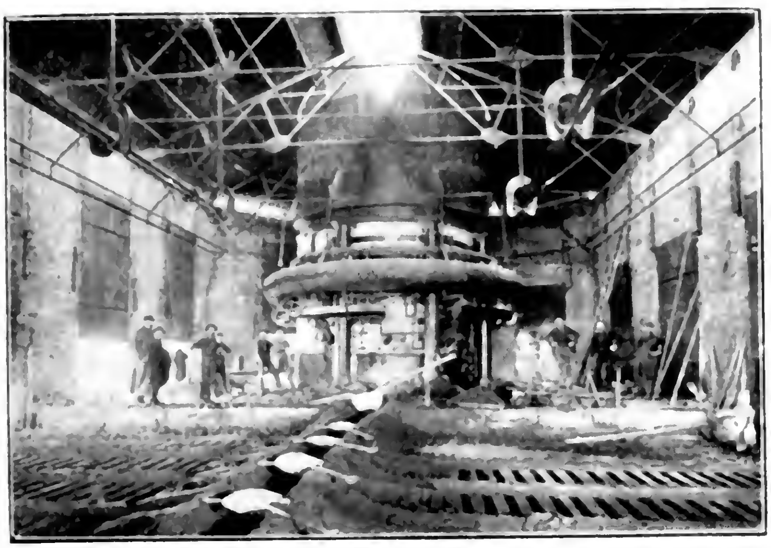
Export trade to Europe.

The inventor's confidence in calcium carbide.

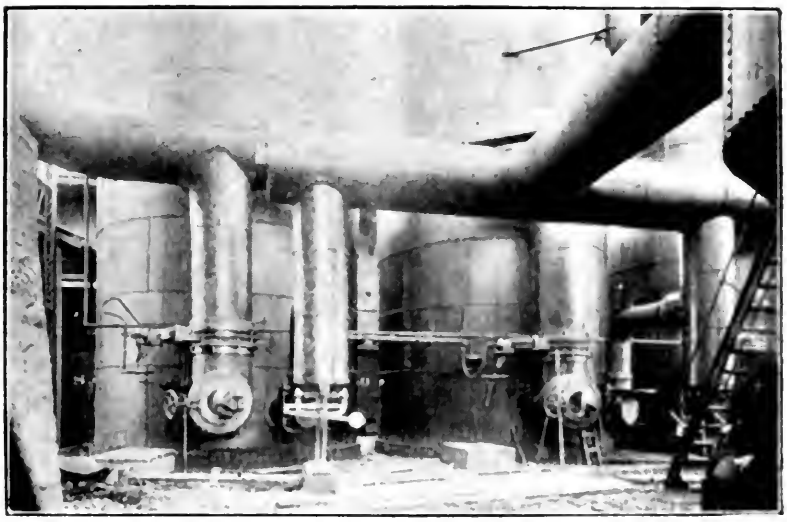
Mr. Willson's faith in the future of calcium carbide and his faith in the advantages offered by Canada, especially by Ontario, for its manufacture are alike great. But it must be admitted that he is proving his faith by his works. He has undertaken the expenditure of a large sum of money in order to put his ideas into effect, and professes his willingness to extend his works and build new ones in order to keep abreast or even in advance of the demand. He asks no bonus, exemption from taxes, or special privileges of any kind. He



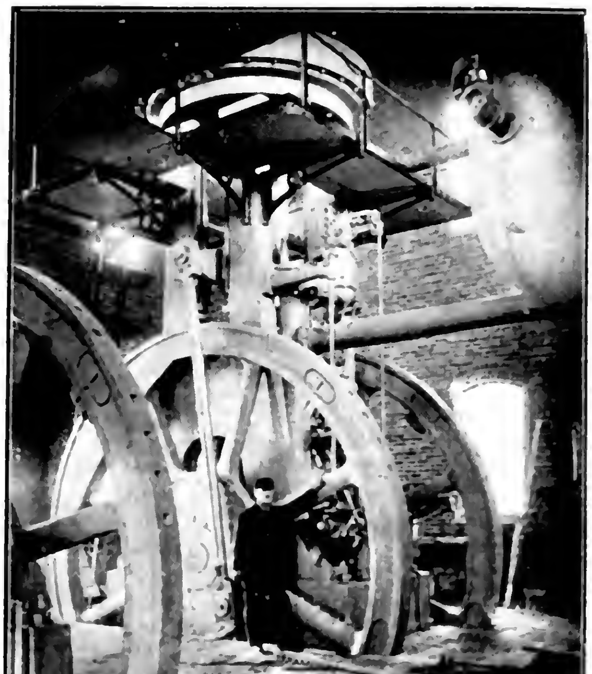
Hamilton blast furnace works, showing stockhouse, hot-blast stoves and office, p. 41.



Hamilton blast furnace works, showing furnace and cast room, pp. 42 and 45.



Stoves for generating hot blast at Hamilton furnace p. 43.



Blowing engines of Hamilton blast furnace, p. 46

believes his business is a legitimate one, and one that will pay. A man who will invest his capital in developing the natural resources of the country is entitled to consideration, and the public in general will hope that Mr. Willson's reward will be commensurate with his energy and his pluck.

THE HAMILTON BLAST FURNACE.

In accordance with the terms of the subsidy granted by the city of Hamilton, the iron smelting furnace erected by the Hamilton Iron and Steel Company was blown in at the close of 1895, although actual smelting operations were not commenced until several weeks later. The contract for the works was entered into by the Philadelphia Engineering Works, and although unlooked-for delays occurred in the undertaking, the terms of the agreement were faithfully carried out, and a plant complete in every one of its details is the result. It is in all respects a thoroughly good and substantial furnace, possesses all the modern improvements and is capable, when driven at its highest speed, of turning out 200 tons of pig iron per day, when using 60 per cent. ores and Connellsville coke. It is constructed to obtain the highest economy in consumption of fuel and in handling of materials. It is also furnished with blowing engines of the cross compound type, in order that the steam which the blast furnace generates may be used for other purposes besides those of the furnace itself. The blast is heated by three 19 by 60-foot firebrick hot blast stoves of the Gordon-Cowper-Whitwell patents, which have proven elsewhere to be not only eminently satisfactory, but very durable. The casing and valves of these stoves are suitable for a working pressure of 20 lb. per square inch, and all the furnace construction, as well as the piping, are made suitable for this pressure; for, although it is not expected that so high a pressure will be used in practice, experience has shown that substantial work is the only thing suitable for continued driving, according to the American idea of pig iron production. In accordance with the contract, the foundations of the furnace, cast house, boilers and boiler house, stoves and hoist tower, engines and engine house, stock house, pumps and water column, are of the most suitable material, principally limestone. Upon these foundations are constructed:

The Hamilton Iron and Steel Company's furnace.

Contract for the works.

The plant.

One blast furnace, 16 feet in the bosh and 75 feet high.

One wrought iron hoist tower.

Three firebrick hot blast stoves, 19 feet in diameter and 60 feet high.

One pair of cross compound condensing blowing engines, steam cylinders 42 by 60 inches, stroke 60 inches, with independent condensing machinery, feed water heater, boiler feed pumps, circulating pumps, etc.

One engine house, 42 feet 6 inches by 47 feet 6 inches inside, 28 feet to the square.

One stock house, 82 by 233 feet to centres of posts.

One cast house, 50 by 160 feet.

Twelve boilers, 59 inches in diameter, 24 feet long, with five 12-inch flues.

One boiler house, 50 by 118 feet.

One draught stack for boilers, 75 inches in the clear diameter by 125 feet high.

Connecting these several parts there is the usual piping, consisting of the hot blast main and connections, gas main to the stoves and boilers, and cold blast main from engines to stoves, all constructed to the following specifications:

Specifications.

Sole plate and columns.

The sole plate of the furnace is 26 inches wide and each segment tapers from $2\frac{3}{4}$ inches to 4 inches in the center, entirely surrounding the furnace, there being seven segments and a column in the center of each. The barrel of the columns is 18 inches at the bottom, tapering to 16 inches at the top and has an average thickness of $1\frac{1}{2}$ inches, the total height being 18 feet 7 inches.

Mantel plate.

The mantel plate consists of two 15-inch I beams of heavy section, well braced together with separators of approved form. On top of these is riveted a cover plate $\frac{1}{2}$-inch thick, on each edge of which is riveted a 4 by 4-inch angle iron.

Shell.

The furnace casing is 21 feet in diameter at the bottom and 18 to 19 feet at the top. The first ring is [illegible]-inch, the second and third rings $\frac{3}{8}$-inch, and the rest $\frac{5}{16}$-inch thick. The entire shell is double riveted in the perpendicular seams to secure the strongest joints of this form, and the horizontal joints are single riveted.

Platform and bridge.

The platform and bridge are composed of $\frac{5}{16}$-inch plate iron, butt-strapped and riveted with countersink rivets, the straps being underneath to present a smooth surface for rolling the barrows. Around this platform is a 42-inch guard rail $\frac{5}{32}$-inch thick, stiffened with a 2-inch angle iron and braced on the straight sides leading to the hoist tower. The extending platform is secured to the shell of the furnace by a 3 by 3-inch angle iron, and the guard to the platform by a 2-inch angle iron. The bridge is supported by three 15-inch I beams, 150 lb. section.

Bell and hopper.

The bell is 8 feet 4 inches in diameter, $1\frac{5}{8}$ inches thick in the body by $2\frac{3}{8}$ inches at the edge, swung by two links $1\frac{1}{2}$ by 6 inches from the 15-inch I beam, and operated by a 12-inch steam cylinder arranged with steam cushion, both top and bottom, to prevent jarring in case of careless handling. The bell sets against a lip-ring 18 inches deep, of the same thickness as the bell. The hopper is 11 feet 6 inches in diameter and 3 feet deep, made in segments, resting upon a hopper ring $16\frac{1}{2}$ inches wide, with an average thickness of 2 inches. This hopper ring is carried by a series of brackets riveted to the furnace shell, with four surfaces planed upon it to which are bolted four uprights carrying two 10-inch cross beams, and to these are bolted the bearings for the lever beam carrying the bell. To the lever is attached the cross-head of the 12-inch oscillating steam cylinder and the counterweight box, which latter is secured by two rods $1\frac{1}{4}$ by 4 inches.

Down-comer.

The down-comer is 60 inches in diameter and $1\frac{1}{4}$ inches thick.

Bleeder.

The bleeder, a pipe through which surplus gas may escape, is 24 inches in diameter and 20 feet high.

Dust-catcher.

The dust-catcher is 12 feet long and 11 feet high, below which is the hopper bottom. It is provided with ladder and doors.

e pipe.

The bustle pipe (the pipe around the base of the furnace for conveying gas to the tuyeres) is 35 inches in diameter and about 25 feet across from centre to centre, constructed of $\frac{1}{4}$-inch soft steel, closely riveted and caulked and swung by seven 2-inch bolts from cast brackets riveted to the furnace casing. To this bustle is riveted six tuyere pipes of the Gordon patent, with ball joints.

Tuyere pipes. The tuyere pipes are 8 inches in clear diameter after lining. Six bronze tuyeres are inserted in six bronze coolers, the tuyere nozzles being of 6 inches diameter.

Water pipe. The feed water pipe is 7 inches in diameter, and the waste water trough 11 by 12 inches.

Bosh bands. There are five bosh bands below the mantel, each 8 inches by 1 inch, with two drawbolts at each joint $2\frac{1}{2}$ inches in diameter.

Hearth. The hearth jacket is of steel joined by draw joints, with heavy bolts and washers; it is 6 feet 4 inches high, 16 feet diameter and 1 inch thick, and to it is bolted a dry notch through which pass two cinder arches where it is reinforced. The cinder arches are of bronze, with bronze notch and fitted with iron pipe. An outside jacket forming a trough extends around the furnace inside of the base plate, 2 feet 6 inches high, $\frac{1}{2}$ inch thick and about 17 feet 6 inches in diameter. The brick work of the furnace commences at the bottom with four courses of 12-inch brick. The hearth is 16 feet in diameter, 10 feet inside and 4 feet 4 inches high. From this point the wall is 27 inches thick throughout the entire boshes, built of a good quality of firebrick; and all the water fittings are of brass

Hoist. The hoist is equipped with double wire ropes of 1 inch, with 12 by 12-inch cylinders, cages 7 feet 6 inchs by 9 feet and an automatic safety device with wooden guides. The engine house at the foot of the tower is of brick, 10 feet 11 inches by 12 feet 5 inches, while the tower itself is constructed of six columns 108 feet long, each composed of 2 by 8-inch channels, the base of which is a sole plate resting on stone foundations. The roof is of substantial angle iron pieces, covered with No. 20 corrugated iron. A 3-foot overhang, with wooden flooring, is arranged where the men receive the buggies and push from them without the least delay.

Stoves and valves. The hot blast stoves are three in number, of the Gordon-Cowper-Whitewell pattern, with 19 feet diameter of casing and height from bottom to top of 60 feet. The shell is of plate iron [illegible]-inch thick. The top is conical in shape and is constructed of plate steel $\frac{3}{8}$-inch thick. Above the conical top is a chimney casing 40 feet high, the base being of plate iron $51\frac{3}{8}$ inches in diameter. The chimney valve is erected on this base, with a clear diameter of 36 inches, and the casing above it is 42 inches diameter, of iron plate $\frac{1}{4}$ inch thick gradually thinning to at the top. A circular platform 24 inches wide is fastened to the top of each stove, the flooring plates being of cast iron supported upon angle irons secured to the top casing of the stoves. A hand rail of $1\frac{1}{2}$ by $1\frac{1}{2}$-inch angle iron that is supported with 2 by 2-inch angle iron uprights or bannisters forms part of the platform. The operators may readily pass from one platform to another at the sections where they touch. The cold blast valve is of the Gate type and is 24 inches in diameter, the body being $\frac{3}{4}$-inch thick and the flanges 1 inch. It is provided with a pilot relief valve and is operated with rake and pinions. The hot blast valve connections have a casing 40 inches in diameter of plate iron $\frac{1}{4}$-inch thick and attached to the stove casing with a flanged branch of [illegible]-inch steel. It is of the same type and size as the cold blast valve. The body is of cast iron $1\frac{1}{4}$-inch thick, bolted between a pair of heavy cast iron flanges. The gas valve is a plate of cast

iron $2\frac{1}{2}$ inches thick, planed up true and operated back and forth by means of a rake and pinion in a horizontal direction between the two flanged parts of the body. The valve is always in view so it may be kept clean ; if through carelessness it should leak the hot blast cannot enter the gas flues, but will pass directly into the atmosphere. The air valves are 18 inches in diameter in the clear, and are bolted to the hot blast valve casing branch. The chimney valve is also of the Gate type, 36-inch diameter in the clear and made of plate iron. The arrangement of the valve and seat is such that the draft of the chimney secures the passage of a strong current of cool air through them, which gives ample protection against the heated gases. A ladder extends from the ground level to the top of the stove casing, and is securely fastened to the shell. The bottom cleaning doors, one for each stove, are 20 inches diameter in the clear. On the conical top are six doors, each 16 by 20 inches. The walls of the combustion chamber are curved, the wall next the casing being $22\frac{1}{2}$ inches thick, and the one between the chamber and first down pass 18 inches thick. The inner $13\frac{1}{2}$-inch wall is built independent, or without bond, so permitting this part to be exposed. It is laid with extra No. 1 fire brick, and bonded every fourth course. The checker work or filling in the down passes is built on lintels forming 9 by 9-inch square flues, with division walls of fire brick. The chimneys are lined to a clear diameter of 36 inches with No. 2 fire brick.

Gas main.

From the dust catcher in the blast furnace a 40-inch gas main extends across to the face of the stoves, and from this are down pipes 30 inches in diameter, terminating with balanced conical explosion and cleaning doors. These 30-inch pipes serve as a support and cleaning arrangement and safety attachment for this portion of the gas connections. The 40-inch main and 30-inch gas pipes are made of iron, riveted and fitted, and lined with firebrick throughout. From the 30-inch gas mains an 18 inch gas connection provided with expansion and ball joints extends to each stove, joined to the valves. From the dust catcher a down pipe carries the gas into an underground flue, and thence the gas is conveyed through the flue across the face of the boilers. From the flue the burners for the boilers receive their gas, and through them it is supplied as fuel to the several boilers for generating steam. The hot blast main commences with the cast iron flange upon the hot blast valve, to which are riveted three branches 40 inches in diameter. Across the top of these, and riveted to them, extends a 40-inch hot blast main about 60 feet long, which terminates at each end with a cast iron flange. To this is riveted and attached with a gusset, to permit of free movement of air, another 40-inch main which extends to and is riveted to another gusset and to the 33-inch bustle pipe surrounding the furnace. The connection of this 33-inch pipe to the 40-inch pipe is so spread as to give it the same arc as the 40-inch pipe. Upon this is riveted a 10-inch automatic gas escape valve, and also a cold air direct branch which is provided with cut-off and automatic valves and attached to the cold blast valve. The whole of the main is lined with firebrick to a clear diameter of 24 inches. It is supported at convenient intervals with iron uprights.

A cold blast main is attached to each of the engines, commencing with a 24-inch cold blast valve, the scaling of which is practically tight against pressure either way. To the valve is bolted a flange riveted to a 24-inch upright pipe or branch to the horizontal main. This main crosses the engines and extends to the stoves, practically horizontal. To it is riveted an upright branch, and this to a horizontal branch crossing the top of the stoves. To this horizontal branch on top of the stoves are riveted three branches, which with their cast-iron flanges are bolted to the cold blast valves of the stoves. To the three ends of this pipe and at sundry points within it are riveted flanges, and upon these three ends blank flanges are bolted. Within the horizontal pipe is bolted a 24-inch cut-off valve, and upon it is riveted a 10-inch safety valve. This entire cold blast main is made of plate iron $\frac{3}{16}$-inch closely riveted and caulked throughout. Each connection, whether from the engine or the stoves or from one part of the pipe to another, where square bends occur, is provided with a gusset to ease the flow of air and give it practically the effect of a round elbow. Cold blast main.

The boiler plant consists of twelve boilers, each shell 59 inches in diameter and 24 feet long, each containing five 12-inch lap-welded tubes, and across each pair of boilers is a 30-inch by 9-foot steam drum connected with two 12-inch legs 3 inches long. Each pair of boilers constitutes a battery, and two boilers are in one setting of brick-work so that they may be thrown out while the others are in use. One firing arrangement is provided for each pair. The gas is conducted to each boiler through a 10 by 16-inch Gordon patent burner to one side of the front. Upon the foundation is placed a cast-iron fire front, supplied with firing and ash-hole doors, so that coal or other fuel may be used instead of gas. The side and walls are of brick-work 18 inches thick, half firebrick and half red, half-way back beyond which the firebrick is reduced to $4\frac{1}{2}$ inches; the same thickness of firebrick is in the central wall, but the total thickness is $22\frac{1}{2}$ inches. The gas combustion chamber is entirely of fire brick, and so are the grate walls and the back wall, retained by angle irons from front to back, and across the back of the setting, and each in turn by three sets of brick stays set in cast-iron sole plates extending to and locked into the inside of the foundation. The upper end is held by bolts extending across the battery. To blow off the flues a 3 inch pipe connection is made with the horizontal main steam pipe and provided with a valve. From this it reaches to and connects with the 3-inch pipe extending across the whole twelve boilers, and from this pipe connects with a 5-way blower. This blower has 1-inch nozzles pointing directly into the centre of each flue, so that by opening the connections at the main steam pipes each of the boilers may be successfully blown, the dust passing through into the tight breeching and thence into the chimney. Boiler plant

The cast house is 50 by 160 feet, measured from the centre of the furnace to the centre of the end wall, besides which it surrounds the furnace in octagonal form. The walls have arched openings of various sizes, each supplied with cast-iron hinge plates, upon which the doors may swing or be taken off according to the requirements of the weather. The walls are Cast house.

22 feet high to the square and 13 inches thick. The roof is a heavy truss framing, covered with corrugated iron.

Chimney.

The chimney is 75 inches in clear diameter and 125 feet from the top of the foundation, and is lined its entire height with firebrick.

Feed pumps.

To feed the boilers two duplex steam plunge pumps are provided, steam cylinders 8 inches, water plunger 5 inches, stroke 10 inches. They receive water from the hot well and discharge it through a heater situated in the exhaust pipe of the condenser. The heater is 1,500 h.p., containing 500 square feet of heating surface, of solid drawn brass piping, the bursting strength of which is 1,400 lb. per square inch. From this heater the water is led to the main feed pipe of the boilers.

Circulating pumps.

For circulating the water required for the plant there are provided two duplex pumps with 14-inch steam cylinders, 14-inch water cylinders and 15-inch stroke. These pumps receive water from the lake by a main cast-iron pipe, and discharge into a stand-pipe 12 feet in diameter and 60 feet high, from which it is distributed through pipes to the furnace and cast house, as well as to hose for fire protection to the different parts of the plant.

Engine.

The engine is of the cross compound condensing Corliss type, with steam cylinders 42 by 72 inches in diameter, and two 84-inch blowing cylinders, one being placed in tandem to each cylinder and having a stroke of 60 inches. The fly wheel is 24 feet in diameter, built in ten segments and bolted to a box from the centre. The total weight of the wheel is 100,000 lb. These engines, together with the condensing apparatus, heaters, feed pumps and circulating pumps, are situated in an engine house 47 by 65 by 18 feet in the clear, built of brick 13-inch walls. The blowing capacity of the engines is 30,000 cubic feet per minute to a pressure of 15 lb. above the atmosphere.

First run of the furnace.

The first run of metal from this furnace was made in the presence of a large number of visitors from Hamilton and Toronto, on the 5th day of February of this year, the ore smelted being a mixture of hematite and magnetite from mines in the county of Hastings, and some hematite from a mine near Rochester, N. Y. A part of the first pig of this first run has been placed in the collection of the Bureau of Mines in the Parliament Buildings, where it will be preserved as a memento of the opening ceremonies of the Hamilton furnace.

Officers of th Company.

The Company has an authorized capital of $1,500,000, and the amount of stock taken up at the date of the first production of pig metal was $340,000. The officers of the Company are: President, John H. Tildcn; vice-president, John Milne; secretary-treasurer, Robert Hobson; directors, A. T Wood, M.P., William Southam, Cyrus A. Birge, R. R. Morgan, George Hope and Æmilius Jarvis.

SECTION II.

SECOND REPORT ON THE GOLD FIELDS OF WESTERN ONTARIO.

By Dr. A. P. Coleman, Geologist and Mineralogist of the Bureau.

Completing the outfit for the season's work.

Following the instructions of Mr. Archibald Blue, Director of the Bureau of Mines, the work of examining and reporting upon the gold fields of western Ontario, begun in 1894, was continued during the summer of 1895. Mr. Edward Burwash, B. A., was appointed geological assistant, and performed his duties diligently and with intelligence. Leaving Toronto on the 20th of June, the party reached Rat Portage on the 23rd, and proceeded to purchase the necessary supplies and to complete the equipment left in charge of Mr. William Margach, crown timber agent, at the close of the previous season. A third Peterboro' canoe was secured, as it had been found during the summer before that a bark canoe caused delay where rapid travel was desirable.

General outline of the regions examined and places visited

As the Lake of the Woods gold region had been visited and reported upon by Mr. Blue and the writer in previous years, it was deemed unnecessary to visit any of the mining camps near Rat Portage, but a short canoe trip was made to the newly discovered deposit on Bag bay, an arm of Shoal lake, near the boundary of Manitoba.

On June 30th the steamer Edna Brydges was taken for Fort Frances, where the outfit was completed, and two halfbreeds, Alexis and Nicol Mainville, were engaged as cook and canoeman respectively. They proved reliable and efficient. On the 3rd of July the party started north by Rainy lake to lake Manitou and lake Wabigoon; and on the 13th reached the Hudson Bay Company's post at Lonely lake, in Keewatin, just north of the boundary of Ontario, where a new find of gold had been reported in the newspapers.

On the 26th of July the party had returned to Fort Frances, and on the following day set out for Savanne by the Seine and Atik-okan rivers, visiting the Shoal lake and lake Harold mines on the way.

At Savanne the party was joined by Mr. Blue, and an expedition was made under the efficient guidance of Mr. James Hammond to the Huronian mine and other interesting points in Moss township; and afterwards to the Mattawin iron deposits near Finmark.

On the 23rd of August Mr. Blue and party set out for Fort Frances and Rat Portage by the Seine river, taking our canoes and halfbreeds; while we went to Fort William, and after a few days spent in visiting the Silver Islet mine and the McKellars' new gold discovery on Jackfish bay, returned to Toronto, which was reached on the last day of August.

During the summer more than a thousand miles of canoe travel were accomplished, and all the more important localities for gold in the pa

Ontario west of lake Superior were visited, with the exception of a few which had been examined the summer before.

Acknowledgements.

The writer desires to acknowledge the courtesy and assistance rendered by prospectors, miners and Hudson Bay officials during the summer. The names of Mr. Jabez Williams, who represents the Hudson Bay Company at Lonely lake; of that intelligent prospector, Mr. James Hammond, of Fort William; of the Messrs. McKellar, of the same town; of the Messrs. Wiley, of Port Arthur; and of the Rev. George Prewer, missionary at Wabigoon Tank, deserve especial mention.

Geological maps.

It is almost needless to say that the maps and reports of the Geological Survey of Canada have been made use of in all parts of the region which they covered, Dr. Lawson's work on the Lake of the Woods and Rainy lake and river being of special value. I wish to thank Dr. Dawson, Director of the Geological Survey, for his courtesy in providing advance sheets of the map now in preparation to illustrate Mr. McInnes's completion of Mr. Smith's work on the Seine river region. These maps have been of great service in preparing the portion of the present report refering to that region, and with the forthcoming sheets covering the rest of the territory known to be more or less auriferous will be of great value to explorers.

THE WESTERN ONTARIO GOLD FIELD.

Area covered by the summer's work.

The summer's work covered roughly the whole length of that part of Ontario lying between Finmark, near Thunder bay, and the Manitoba boundary; and also crossed the Province transversely between Minnesota on the southern shore of Rainy lake and Keewatin on the north shore of Lonely lake; about two hundred and seventy miles from east to west, and one hundred and fifty from south to north. In this way it was possible to get a somewhat comprehensive view of the region as a whole; but no attempt was made to work out the geology of the region generally, since work of that kind belongs properly to the Geological Survey of the Dominion.

Its geographical and topographical characteristics.

Geographically the whole region belongs to the Hudson bay drainage system; for, with the exception of lake Shebandowan and the Mattawin river, which empty into lake Superior, and so belong to the St. Lawrence system, all its waters flow more or less directly into Winnipeg river, which empties into the lake of the same name, and ultimately reaches Hudson bay by the way of Nelson river. By far the greater part of the region traversed belongs to the "rocky lake country," only a minor portion of the surface being covered with alluvial soil. A relatively large part is covered with water in the form of lakes without number and of all shapes and sizes, many of them apparently rock-rimmed basins and others evidently dammed by glacial deposits. Topographically the country may be described as an old peneplain, worked down by long erosion of weather and water to something approaching a level; then elevated and carved by running streams, and finally scoured in some places and loaded with debris in others, by the action of glaciers. It is a very difficult country to traverse except by canoe. In

fact, away from the railway, the Lake of the Woods, and Rainy lake and river, the canoe is the only practicable means of travel.

The Lake of the Woods is much the largest body of water in the region; Lonely lake, which is more than a hundred miles long, comes next; Rainy lake third; and after this a host of sheets of water ranging from lakes twenty-five or thirty miles long to the tiniest ponds. The land surface is often hilly, and often rises precipitously above the adjoining waters, forming rugged cliffs, but the greatest height attained does not exceed a few hundred feet, and no elevation occurs worthy of the name mountain.

Geology of the region.

The account of the general geology of the Rainy Lake region given in the Report of the Bureau of Mines for 1894,[1] taken from Dr. Andrew C Lawson's excellent description of that district,[2] will apply as a whole to all the new districts visited, except that of the Mattawin iron deposits near Finmark. Gneiss, with associated granite or syenite, will be spoken of as Laurentian, even though it proves to have solidified later than the adjoining or overlying Huronian schists. The gray mica schists and gneisses of the Couchiching however have not been certainly recognized, and will scarcely be referred to. The green schists and associated eruptives, as well as the lighter-colored later sericite schists, with their accompanying quartz porphyries, described last year under Lawson's term Keewatin, are widely found and will usually be spoken of under the general term Huronian.

Visit to Bag Bay, Shoal Lake.

A new gold district west of Lake of the Woods.

Having engaged Mr. J. S. Whiting, an intelligent and enterprising prospector and steamboat pilot, as guide and canoeman, we left Rat Portage in two canoes on June 25th for Bag Bay, an arm of Shoal lake, ten or twelve miles east of the boundary of Manitoba, where a new gold location had been discovered. My object was to compare this most westerly and newest gold district of the Province with better known points farther east. The outward journey was made through the charmingly picturesque island scenery of Ptarmigan and Echo bays of the Lake of the Woods. Two portages led over into Clytie bay, an arm of Shoal lake, which opens into Bag bay. The general course is about west by southwest of Rat Portage, and the distance by the route followed about thirty-five miles.

As the geology of the region has been well described and mapped by Dr. Andrew C. Lawson,[3] little need be said of the rocks observed by the way, chiefly green chloritic or brownish sericitic schists of the Keewatin. At the narrow entrance to Echo bay a four-foot seam of crystalline limestone containing some copper pyrites was observed in the sericitic schist. This is not very pure, containing some quartz, etc., but may at some time be of value for lime.

Bag bay gold location.

The Bag bay gold location lies on a small point on the southern side of the bay in an area mapped by Dr. Lawson as granite, and having a length of five or six with a breadth of three miles. The location is near the contact

[1] Page 45, etc. [2] Geol. Sur. Can., 1887, p. 22F, etc.
[3] Geology of the Lake of the Woods Region, Geol. Sur. Can. 1885, part CC.

with green Keewatin schist, and at the southwest end of the granite tract. Its discovery was made in a somewhat romantic way. An Indian crossing the portage from Helldiver bay, which lies a mile to the south, dropped his axe as he came down to the landing at Bag bay and thus knocked off some moss. Stooping to pick up the axe, he saw something glitter and picked up several specimens which he brought to Mr. Bunn, Hudson Bay officer at Rat Portage. The pieces brought in were brilliant gold specimens, and Mr. Bunn and Dr. Scovil of Rat Portage took up the location.

An auriferous vein in a granite tract.

The way in which the deposit was found is very suggestive of the difficulties of prospecting in this region, where so much of the rock surface is covered with moss. Doubtless many rich veins are still hidden away where least suspected.

At the time of our visit no development work had been done except stripping and the putting in of a few blasts, so that our examination was not very satisfactory. So far as could be seen the deposit consisted of a quartz vein about six feet wide, dipping nearly vertically between distinct walls, and having a strike of about southeast and northwest. It could be traced for nearly a hundred feet, i. e. as far as the stripping allowed, and appeared to sink at each end beneath the muddy soil of the swamp. The country rock is of granite, partly greenish gray, like that of the Shoal lake region of Seine river, partly flesh red. An account of thin sections prepared from this rock will be given in the part of this report devoted to petrography; but it may be noted here that many of the most brilliant gold discoveries made in the Lake of the Woods region during the last few years have occurred in granite areas near the contact of Keewatin schists, so that prospectors are beginning to search these contact zones with special care.

Though bush had been cut and thrown over the part of the vein that had been blasted, we had no difficulty in knocking off some fair specimens of quartz with free gold, and the young Swede who kept guard in a shanty close by showed us still richer ones, though not equal to the brilliant examples of gold in quartz and galena displayed by Messrs. Bunn and Scovil at Rat Portage.

The associated minerals were found to be iron and copper pyrites and galena. Much of the glaciated, *roches moutonnees* surface showed rusty quartz, but we had no means of determining whether the whole length of the vein is as rich as the spot where the blasting had been done.

Until the property has been much more completely developed it would be rash to give an opinion as to its value, but what we saw looked very promising. The quartz is crystalline in look and not of the cryptocrystalline, quartzitic type found at the Sultana mine.

At a point a mile north of Bunn and Scovill's location, near the entry of Bag bay, the same vein is said to crop out. Here we found rusty, cellular quartz with pyrites, galena, molybdenite and tourmaline, but saw no free gold; nor had enough stripping been done to make it clear whether there was a distinct vein or not.

Leaving Bag bay and going south round the peninsula which separates it from Shoal lake, we visited Helldiver bay where some quartz occurs near the contact of an eruptive rock, quartz porphyry, with green schist. The quartz or quartzite is in small veins not more than two feet wide, striking north and south, and does not seem highly mineralized; though dark quartzitic material near by is heavily charged with pyrrhotite and a little copper pyrites. It is not likely that these veins are connected with the auriferous one a mile to the north on Bag bay. Veins on Helldiver bay.

Soon after entering Helldiver bay we saw what appeared to be a camp, and paddling up found a recent grave, evidently that of a child, the most elaborate Indian grave which I have seen in Ontario. It was placed in the middle of a small clearing on a prominent point sloping towards the bay. The tallest spruce in the clearing had its lower branches trimmed off, leaving a conical top as a "lobstick," or beacon. Near the lobstick, in the midst of a little vegetable garden, there stood a sort of double tent, the inner, smaller one of red cotton. Round the foot of the second tent were all the appliances for the unknown voyage; the tiny toboggan, canoe and paddles, hatchet, bow and arrows, and bunch of birchbark and firewood with a box of matches, needed for the journey. Some colored pebbles and other trinkets were to amuse the little one in its loneliness. In front of the tent a flag pole was placed and every motion of the flag in the breeze set a little bell tinkling. Grave of an Indian child.

Our return journey followed in part a new route, Shoal lake narrows, Ash rapids and Ash bay into Ptarmigan bay. Ash rapids receive their name no doubt from the ash trees growing there; and indeed it was a surprise to find so rich a growth of deciduous trees so far north, a sort of island of leafy trees in the midst of the monotonous forest of conifers, poplar and birch. Besides ash we observed oak, basswood, thorn trees, choke cherries and wild plums near the rapids; but no evergreens. Not far from here, just within the entrance to Echo bay, there is a small patch of cactus, apparently of the same species as grows on Red Pine island in Rainy lake, Opuntia fragilis. These two spots are, so far as I am aware, the only localities where cactus grows in Ontario. Flora of Ash rapids. Another cactus locality

Our journey was made during the whitefish season, and we had plentiful opportunities to supply ourselves with fish, which seemed the most delicious I had ever tasted. Here and there along the shores or on islands one finds a shanty, reoccupied generally by a thrifty Scandinavian who fishes during the season, selling the product to companies which send around small steamers to collect the fish. At other times these hermits cut cordwood and cultivate a few acres of land in vegetables for the Rat Portage market. Whitefish.

The Manitou Region.

On June 29th we left Rat Portage for Fort Frances on the steamer Edna Brydges, and after a voyage south on the Lake of the Woods and east on Rainy river, reached Fort Frances early in the morning of Dominion day, having been delayed by the breaking of flanges of the screw on Rainy river. Rat Portage to Fort Frances.

The unavoidable delay in completing our equipment and securing two Indians, Alexis Mainville, who was with me the year before, and his brother Nicol, was partly employed in examining the stratified fossiliferous drift on the shore of the river just below the Hudson Bay post; but the results of this work will be made use of in describing the glacial and post-glacial deposits of the region.

From Rainy lake to Manitou lake.

On the 3rd of July we united with a surveying party and a number of prospectors who were going to the Manitou in chartering the small steamer Maple Leaf for the voyage to the Devil's cascade, where the portages leading from the northern arm of Rainy lake to lake Manitou begin. The previous year we had taken a circuitous route to the Manitou, via Despair, Clearwater and Pipestone lakes, so that I was anxious this time to traverse the most direct route between the two lakes.

A region of Laurentian gneiss.

From the beautiful Devil's cascade where the waters of the Manitou chain of lakes fall into the most northerly projection of Rainy lake, Manitou sound, to Cedar narrows just below Pickerel lake, the whole region is Laurentian gneiss, so far as observed, sometimes flesh red, sometimes gray, and barren of minerals. The waters traversed are clearer than those of Rainy lake, as one would expect from the character of the Manitou lakes themselves, and there is a romantic succession of short rapids or falls with intervening lakes and stretches of narrow weedy creeks. The portages are numerous, and some of them muskegy, but none of them long.

The Manitou lakes.

The Manitou chain of lakes, begins on the south side of Pickerel lake, separated by only a short bit of current up which one can paddle, from the long southwestern extension of Lower Manitou. Then comes the large expanse of Lower Manitou with numerous islands at its upper end; followed by another narrow stretch, ending with Upper Manitou, which is really an archipelago. The prospectors of the region name the lower expansion "Big Manitou," and the Upper one "Little Manitou"; but the names given by the Crown Lands Department on the maps included in the Report of the Bureau of Mines for 1894 seem preferable, since the two main expansions of the lake are nearly equal in size. It might be better to give a distinct name to Upper or "Little" Manitou, since at most seasons there is a very considerable current flowing out of the narrow channel connecting it with the rest of the lake. Why the suggestive name of Manitou was given to this lake by the Indians, I have been unable to discover; but that some superstitious belief is responsible for it seems certain, for no Indians are seen on this beautiful chain of waters except parties making their way between Rainy lake and the rice beds of the Wabigoon.

The syenite area of Caribou lake.

Since the general geographical and geological features of the Manitou region were described in the previous volume of the Bureau of Mines Reports,[4] it will be unnecessary to say anything further regarding them here, except to mention that the Caribou lake syenitic area, found the previous summer, was re-examined and fresh specimens obtained, and a study of them makes it probable that the syenitic mass belongs to the so-called Laurentian rather than to the group of ordinary eruptive granites. This point will be further

[4] Vol. IV., p. 62, etc.

discussed in the petrographical portion of the report. The highest point of this syenite mass rises two hundred and thirty feet above lake Manitou.

Since our last visit to Manitou the region has attracted much attention from prospectors, and surveying parties have been kept busy laying off locations. Most of the recent finds have been in the country between the two expansions of the lake; and very rich specimens have been brought from there. The gold is not coarse and nuggety as in the Lake of the Woods region, but disseminated as fine specks, easily overlooked. The quartz often pans very well, and Mr. Floyd, assayer at Fort Frances, reports that some of the rock showing no nuggets assays $250 per ton.

Gold discoveries in the Manitou district.

No development work of any importance has been done up to the present, and we examined only such "prospects" as lay on our course. Lillin and Rochon's property near the entry of the Upper Manitou, on which some work was being done last summer, we found to be deserted. A claim on the same part of the lake owned by several Scandinavians contains a number of small bedded veins showing free gold.

The present mode of access by canoe in summer makes development very difficult. Whether one enters from Rainy lake or from Wabigoon, numerous portages make it impossible to bring in machinery. In winter however the new Wabigoon road gives better connection with the world by means of the Canadian Pacific Railway at lake Wabigoon.

The new Wabigoon road for winter travel.

Continuing our journey northwards, we started for Wabigoon by the route followed last year and found it much less difficult, since the water was higher. We were able to make the journey with only five portages, the third and longest being about three-quarters of a mile. The lake between the third and fourth portages appears to be on the divide; for Alexis Mainville, who is well acquainted with the region, says that it flows both ways. In that case the height of land should pass through the lake, instead of to the north as shown in last year's map of the Manitou region.

The route to Wabigoon.

A lake on the divide, whose waters flow north and south.

The winding river and great fields of rice leading to lake Wabigoon we found much more navigable this year than last, owing to the higher water.

Lake Wabigoon to Lonely Lake.

Rumors of the discovery of gold at Lonely lake, on the northern boundary of the Province of Ontario, made it a matter of interest to visit and report upon the prospects of that region as a gold country. As it turned out, the reports were exaggerated and in some respects quite incorrect; yet this journey, through a stretch of the Province hitherto almost undescribed geologically, proved to be of much interest.

Parts of the region have been traversed by members of the Geological Survey of Canada at several times, and brief references have been made to the lakes and their shores by Dr. Bell, Dr. Selwyn and Mr. Dowling. In 1872 Drs. Selwyn and Bell followed a canoe route from Lac des Mille Lacs, via Lonely lake to the Lake of the Woods; and in his report Dr. Bell gives the results of a track survey of Lake Minnietakie and the lakes and rivers

Early explorations by Selwyn and Bell.

between it and Lonely lake, and also of the western end of Lonely lake itself.[5] In 1886 he set out from Wabigoon for James bay, passing through lake Minnietakie and the eastern end of Lonely lake[6]; but adds little to his former description. In the summary report of the Geological Survey of Canada for 1893 there is a brief mention of Mr. Dowling's journey from Wabigoon to Lac Seul or Lonely lake, but no details of his observations are given, though we may expect they will be published before long.

The maps of the region which I have been able to obtain are very imperfect, and so far as I am aware the only map that has been published showing the route from Wabigoon to Lonely lake is the "Map of the Country between Lakes Superior and Winnipeg," Ottawa, 1884.

Portage from Wabigoon Tank to Sandy lake.

The best point of departure for Lonely lake is Wabigoon Tank, on the Canadian Pacific Railway. This may be reached from Little Wabigoon lake by paddling up Mackenzie river, which enters the lake from the northeast. The landing is a short distance from the railway. Wabigoon Tank is not a station, though trains stop there when signalled. The only white men living at the place are the Rev. George Prewer, Church of England missionary, and the Hudson Bay officer in charge of the store. From the landing on Mackenzie river there is a portage of nearly nine miles northeast to Sandy lake. The Hudson Bay Company have made a road across the portage, and freight is teamed over for the supply of various posts to the north, including Lonely and Sturgeon lakes. The road at the time we crossed was very muddy at first and very stony afterwards, so that the team employed could make only one journey to and fro in a day. This delayed us in crossing, and was specially uncomfortable since the neighborhood of the Hudson Bay post, removed as it is from any body of water larger than the half-choked Mackenzie creek, and with only a small clearing, is a favorite haunt for sand flies, black flies and mosquitoes.

Huronian schist.

The nearest rock to the post is found at a railway cutting a mile and a half east, where a hard, close-grained Huronian schist is exposed. Between the post and Sandy lake solid rock is found only once, about half way across the portage, and then rises as a hill of very contorted Huronian schist. The rest of the portage shows only drift materials, for the first four miles whitish silty clay with black loam covering it in the lower parts. This seems quite free from stones. Then two stony ridges are crossed, probably moraines.[7] The boulders are chiefly gneiss and granite, with a few green schists. Beyond this one finds clay again and sometimes sand, barren looking for the greater part, but covered with black loam in the bottoms.

The better portions of this region, so far as exposed at the portage, consist of good soil, having a rich growth of poplar and other deciduous trees, with some spruces. The more barren clays and sandy tracts are covered with small Banksian pine. The timber is all second growth. There must be a very considerable area of good land between Wabigoon and Sandy lakes,

[5] Geol. Sur. Can., 1872-3, pp. 101-103. [6] Ibid. 1886, pp. 7 and 8 G.
[7] Mr. Dowling mentions these moraines in the Summary Report for 1893, p. 17.

though the vegetable loam has been burnt off at some points, thus depriving the surface soil of its most useful ingredients.

There is an old canoe route between Wabigoon and Sandy lake, making use of two small intervening lakes, but the portages are so grown up, according to report, as to make the long portage preferable.

Since the route to Lonely lake is difficult to find, a guide had to be secured, but unfortunately treaty payments were at hand and none of the Indians on the Wabigoon reserve wished to go with us. At last an "American" Indian, who received no treaty money, was engaged, and we were ready to start on July 11th.

SANDY LAKE.

Sandy lake is a fine body of water six or seven miles from north to south, by four miles from east to west. It contains few islands and these small, so that a sea dangerous to Peterboro' canoes may easily rise, as we had occasion to discover. The water of Sandy lake is beautifully clear, forming a pleasant contrast to the very turbid, brownish waters of Wabigoon lake and its tributaries. The shores are not generally high, and often consist of drift materials covered with second growth woods. The Hudson Bay Company have two large York boats on it to transport supplies and bales of fur from their storehouse at the northeast end of the long portage to the next portage into Minnietakie lake.

Owing to the bad weather and the short time allotted for this lake, on which no indications of gold have been found, we explored only the eastern shores. For about two miles east of the landing at the long portage a rather coarse-grained, reddish gray granite is the only rock found. Here a point which projects displays a small mass of gray schist, seemingly included in the granite, having a strike of 40° east of north. A third of a mile to the northeast contorted grayish gneiss occurs in the granite, and beyond this gray green Huronian schist with a strike of about 70°. In a deep bay on the east of the lake hard, green banded schist with small, bluish quartz veins occur, having a strike of 30°; and on the northeast side of the bay similar schists with more or less contorted bedding show a strike of 20° or 25°.

Exploring the eastern shore.

The point that projects to the south of the portage to Lake Minnietakie consists of coarse-grained porphyritic syenite of a light flesh color. At the portage contorted green schist occurs again, so that the syenite is apparently an isolated boss. An island west of the point is formed of the same rock.

The shore northeast of the Minnietakie portage, for at least half a mile, is of green Huronian schist, but the rest of the shore line was not examined.

Geology of Sandy lake.

Dr. Bell includes Sandy lake in the geological map of the Lake of the Woods,[8] published in 1881, marking as granite an area lying between the south shore of this lake and the northeast shore of Little Sandy lake. The rest of the shore line he indicates as Huronian. The two areas of acid eruptive rocks found by us on the south and east shores of the lake differ greatly in character, one being an ordinary hornblendic granite, the other a porphyritic syenite, so that they probably represent distinct outflows; both

[8] Geol. Sur., Maps for 1880-81-82.

are very much like examples of the so-called Laurention of Rainy lake, but the inclusion of portions of schist proves that they are later than the Huronian in age.

The schists are usually like the harder green Keewatin of Rainy lake, but some parts, especially the large inclusions in granite, are really gneisses or gneissoid mica schist, and remind one of the rocks named Couchiching, in the Rainy lake region. As these were described in last year's report, nothing further need be said of them here.[9] The great variation in the strike and the contortions of the schists probably arise from the disturbance caused by the adjoining eruptive masses.

LAKE MINNIETAKIE.

A name of probable Sioux origin.

Sandy lake empties into Minnietakie with a fall, as measured by aneroid, of twenty or twenty-five feet. However the canoe route does not follow the creek, which flows from the north end of the lake, but crosses a steep portage of a quarter of a mile at the point where the two lakes approach one another most closely. It will be remarked that the name Minnietakie is a foreign one, quite unlike any name given by the Ojibways, but resembling Indian names in Minnesota, *minnie* being "water." It is said that this lake was named by the Sioux, who sometimes made forays in this direction. Our guide could give no explanation of the word.

Extent and general character of the lake.

Minnietakie is more than twenty-seven miles in greatest length, and at some points several miles wide, but it is very irregular in shape, having long, narrow bays toward the southwest and wider stretches with many large and small islands toward the northeast. The eastern part of the lake is given quite incorrectly on the maps, but it seemed inadvisable for us to attempt to map it in the short time allotted to the Lonely lake trip. The water of this lake is beautifully clear, like that of the previous lake; and its shores are usually rocky, though stratified sand rises to a height of about twenty feet near the middle of the southern shore and is washed into beautiful beaches.

Geology of the shore formations, and occurrences of gold bearing quartz veins.

The entrance to lake Minnietakie is by a narrow bay running first northeast, then curving to the east, about seventeen miles long, before the lake widens. A long point separates this bay from a shorter one with more varied outlines to the south. The whole shoreline of this part of the lake consists of Huronian rocks of great variety, chiefly the green schists described by Dr. Lawson in the region to the south as Keewatin. In general the strike of the schist is parallel to the direction of the bay. Just after crossing the Sandy lake portage, the schists are hard and folded. Half way along the projecting points consist of yellowish sericite schist, evidently altered quartz porphyry, and at some places of true porphyry with large blebs of quartz. In the inlets along shore one finds the green schist; so that apparently the bay has been hollowed out of a band of the softer yellowish altered quartz porphyry, the harder portions projecting still as points. A small outcrop of rather fine grained granite or gneiss occurs on the northwest shore not very far from the portage, perhaps in connection with the gneissoid rocks of Sandy lake. A

[9] Bureau of Mines Report for 1894, p. 81, etc.

somewhat lustrous gray clay slate or phyllite is found on the point near the opening of the long bay into the lake.

At several points along the southeast shore of this bay there are veins of quartz more or less charged with sulphides. Fahlbands, i.e., beds of schist containing much sulphide, such as copper pyrites, are also found widely extended along the shore. A claim has been staked by James Mackenzie on a good looking bedded vein of quartz on this shore. Several assays made in the laboratory of the School of Science, Toronto, of quartz and rusty or pyritous schists from this bay, gave traces of gold, but none of the specimens contained more than about $2 per ton. As our specimens were taken so as to give average examples of the more promising parts of the shore line as seen from the canoe, the results must be taken as proving that the region is quite widely auriferous. Whether veins containing rich enough ore to be workable will be found along this part of Minnietakie cannot be said positively, but the region is certainly worth prospecting.

Quartz veins with traces of gold.

The long bay stretching seven miles along the southern shore of the long point just described has on its shore rocks of a quite similar geological character, sheared porphyroids and green Huronian schists, and need not be described in detail.

Northeast of the long point a wider reach of the lake stretches five or six miles, open and mostly free from islands, and then widens to a transverse portion more than ten miles in length from northwest to southeast. This portion, unlike the southwestern end of the lake, is more or less filled with islands, and has its shores greatly cut up with deep bays.

The northwest shore presents chiefly green schists with some veins of quartz and bands charged with sulphides, but two assays of rusty quartz showed only traces of gold. Going northwestward along the southern shore, much of the beach is found to consist of Laurentian boulders at first ; but the only rock found in place is hard, gray-green, and scarcely schistose, and is probably an eruptive rock of Huronian age. This was found on a small island

Clay slate of a dark gray color and showing two directions of cleavage is found west of the bouldery shore and contains some small bedded veins of quartz with sulphides ; then follows a beautiful sand beach consisting almost wholly of garnet and magnetite, derived no doubt from adjoining sand cliffs which rise about twenty feet from the lake and are being undermined and re-arranged by wave action.

Near the point where the shore bends to the south, green chloritic schist is found, but a dark gray slate interbedded with sheared porphyrite occurs at the south end of this arm of the lake. From this point round most of the eastern shore to the outlet of the lake, Huronian rocks of green or gray color, sometimes very schistose, and at others massive looking, are found ; no doubt the "greenish Huronian schists, mostly of a dioritic character," mentioned by Dr. Bell. The islands however, which are many and often large, with narrow channels between, present more variety of constitution. On one of

[10] Geol. Sur. Can., 1872-73, p. 101.

Eruptive diorite.

them a gray-green porphyrite with crystals of white striated felspar half an inch long was obtained; and on another an eruptive mass of greenish-gray quartz diorite, quite like some of the so called "protogine" of the Shoal lake region on Seine river. The same granite-like rock was found to extend to the eastern end of a deep bay on the mainland; but for lack of time its outlines were not completely traced. Near by some very large veins or masses of quartz occur on islands, rather barren looking however in most places. One specimen of very rusty ore from this part of the lake was found on assay to contain only a trace of gold. Near the outlet of lake Minnietakie schist conglomerates make their appearance on both shores, and a specimen of quartz containing sulphides from a vein in these rocks was found to carry $2 of gold per ton.

Structure of rocks near the outlet of the lakes.

The structure of the rocks at this end of the lake is very complicated, perhaps because of the eruption of quartz diorite or the porphyrites, though the latter appear to have been interbedded with the other Huronian rocks. The strike of the schists varies from 35° east of north to 80°, and sometimes within short distances. In general the direction of the edges of the schists is about northeast and southwest, with a dip of 70° or 80° toward the northwest near the outlet of the lake; but, according to Dr. Bell, in the opposite direction at an angle of 60° at the southwestern extremity of the lake, which which was not visited by us.[11] At that point Sturgeon river enters the lake, forming its largest tributary. We discovered another river entering a narrow bay from the south.

It appears that in general the complicated outlines of the islands and bays correspond roughly to the varying strike of the rocks on their shores, the softer layers having been eaten away, leaving the harder ones as projecting ridges or bosses. The outlines of the lake as shown in the map[12] are very far from correct, so much so that we have found great difficulty in placing the points at which observations were made even approximately on the shorelines as given. At least three bays, each perhaps two miles or more in depth, should be represented on the eastern shore, and a similar one on the northwest shore near the entrance to the long southwest bay.

ABRAM'S AND PELICAN LAKES.

Position of the lakes.

A ridge of rock forms a short fall or rapid at the north end of Minnietakie and separates it from a pretty body of water, Abram's lake, which, after being nearly cut in two by a narrows, empties through a short river-like stretch into Pelican lake. Each of these lakes is about four miles broad in a northwesterly direction along the route to Lonely lake, but has its greatest length of perhaps six or eight miles in a direction transverse to this. Like Minnietakie, these lakes have clear waters and green shores not recently touched by fire.

The Sioux lookout.

Abram's lake is stated to be the most northerly point reached by the dreaded Sioux in their warlike incursions, and a hill on its shores, the highest

[11] Geol Sur. Can., 1872-73, p. 101.

[12] Map of the country between lakes Superior and Winnipeg, Ottawa, 1884.

in the neighborhood, has been named the Sioux Lookout, from which they were supposed to watch for the approaching canoes of their unsuspecting enemies of the north.

Geological character of the lake shores.

The shores of Abram's lake are formed of pale greenish gray, felsitic looking schists, sometimes pyritous and browning when weathered, of the ordinary green schists, and of a sort of boulder conglomerate, containing well rounded stones (quartz diorite or granite) a foot through. The southern end of Pelican lake also consists of Huronian, but of harder and more hornblendic schists. A mass of granite rises through them on the shores of the small bay to the southwest, and they are more or less interbedded with the Laurentian rocks of the northern end of the lake, gray gneiss alternating with the hard green schist. This relationship is the same as one finds on Rainy lake when green Keewatin schist comes in contact with so-called Laurentian, really with an eruptive or at least plastic rock of later age than the Huronian schist which it has penetrated and hardened.

The Huronian of these two lakes contains some small quartz veins, but not of much promise. A specimen of the pyritous schist from Abram's lake was assayed, but contained no gold. Dr. Bell reports that a similar schist, probably from the same general locality, assayed by Dr. Hoffmann, also gave no trace of gold.[13]

The "Laurentian" (to use the term generally employed for the gneisses and granites of the west of Ontario, in spite of the fact that they appear to be younger than the Huronian.) of the northern part of Pelican lake consists of gray banded gneisses in part, but also of flesh-colored rocks only slightly schistose and of undoubted granites. Some large inclusions, apparently of Huronian rock, have been metamorphosed to mica schist, and sometimes contain great numbers of garnets.

The general strike of both schists and gneisses is 70° or 80°, though there are sometimes great local variations and the outline of the bays conforms generally to this direction.

PELICAN LAKE TO LONELY LAKE.

A Laurentian region from Pelican to Lonely lake.

From Pelican lake onwards the whole journey was through a Laurentian region, and no attempt was made to follow the variations of the rock with minuteness, since up to the present the Laurentian of western Ontario has proved barren except at its contact with the Huronian.

The route follows Pelican river to the west into Lost lake, and then turns north through a series of small lakes and marshes, including Grassy lake and Canoe lake, until Lonely lake is reached.

Shortly after leaving Pelican lake a series of violent rapids is reached where a portage of about a third of a mile must be made. Just above this, dark red syenitic gneiss was observed on an island. A mile or two to the west the outlet of this chain of lakes turns off to the northeast, reaching Lonely lake by what is called Sturgeon Lake river. This river is navigated

[13] Geol. Sur. Can., 1872-73, p. 102.

by York boats from the Hudson Bay post on Lonely lake, but canoes generally follow the shorter, less exposed route through the small lakes before mentioned.

Frenchman's Head village,

Continuing west, Frenchman's Head is reached on Lost lake, the first point in a large Indian reserve stretching north to Lonely lake. The village is placed at a narrows two or three miles west of the point. The scenery after leaving the rapid is very pretty, but the shores are mostly covered with moss and trees, so that exposures of rock are rare.

and its thrifty inhabitants.

The village is lively and picturesque, and is the seat of a Church of England mission with a neat little church and parsonage. These Indians come very little in contact with white men, and are said to be all the better for that. We camped for the night opposite the village, and presently a swarm of canoes paddled over, and their good natured owners gathered round with great curiosity, especially as to the Peterboro' canoes, which apparently some of them had never seen before. They were never tired of examining them, and the old chief praised them as much better than their own birch bark ones, None of the men we met could speak more than a few words of English, though some of them had been as far into the world as Rat Portage.

These Indians are the thriftiest we have seen. They have luxuriant, well weeded gardens, in which corn, turnips and potatoes were growing; and their houses are built of squared timber, with a roof covered with bark, and a chimney. They whipsaw all the lumber used for doors, etc., and appear to be quite equal to rough carpentry.

Through Grassy and Canoe lakes, into Lonely lake.

Passing the village, the canoe route turns north and makes its way through wide marshy bays, where our guide lost his way for a time. A portage of more than a mile leads northward over level, rich looking woodland to Grassy lake, which is largely a broad marsh grown up with reeds and wild rice. A short creek leads into Canoe lake, from which there is a portage of about half a mile to a stream flowing into Lonely lake. Four miles of very different navigation on a bay, and then past a long sandy point, take one across the lake to the Hudson Bay post on the northern shore.

Character of the exposed rocks along the route.

The rocks exposed along the way are chiefly gneiss, sometimes containing great angular or rounded masses of darker colored rock. At one point the whole rock, which consists of lighter and darker gneiss, seems to have been crushed and re-cemented by a paste of granite, forming a gigantic breccia. At other points the gneiss is well banded and resembles that commonly found in eastern Ontario.

LONELY LAKE, ON THE NORTHERN BOUNDARY.

A picturesque scene at the Hudson's Bay post.

Lonely lake, or Lac Seul, to use the original French, is more commonly called Lake Saul or even Lake Sault, no doubt a corruption of the French name. It comes next in size after the Lake of the Woods in far western Ontario, and forms the boundary for a hundred miles between this Province and the little-explored territory of Keewatin. The Hudson Bay post at which our canoe route ended is planted on a strip of sandy beach just opposite a long sandy point projecting from the Ontario shore, a point that immediately

catches the eye from the fine group of wind-swept white pines standing upon it, giving the name of White Pine narrows to the blue channel separating Ontario from Keewatin.

The first glimpse of the Lonely lake post across the narrows is a great surprise. After all the wilderness of lake and woods, and after the picturesque but humble log cabins of the Indians, one suddenly sees a thoroughly civilized group of buildings, one of the houses a handsome summer cottage in appearance, standing on a yellow sandy shore or among shapely evergreens with wooded hills for a background. Beside the Hudson Bay post with its buildings, a Church of England mission with its pretty church and house gives the place the look of a trim summer resort, and indeed but for the tedious portages of the canoe journey it might very well serve that purpose if western Ontario were not so well provided in other quarters with summer play grounds. There are no Indian inhabitants except one or two employés of the company; but a considerable number live in villages on the two reserves just south of the lake, and at Sunday service the little church is crowded with a well-behaved audience, only half a dozen of whom are white.

The Church of England mission station.

The Hudson Bay post, which is an important center of distribution, is in charge of Mr. Jabez Williams, who takes much interest in the mineralogy of the region, and especially in its gold deposits. The bales of fur collected during the winter are shipped from this post in large, well-built York boats, half a dozen of which were drawn up under a shed on the beach. These boats, which are built here by halfbreed carpenters, carry a sail and a crew of seven or eight and are said to be good sea boats. They are dragged across the portages on a line of skids, two crews uniting to draw a single boat. The planks of which they are built, some of them twelve inches wide, are cut with a whip saw from logs obtained a short distance northwest of the post.

York boats of the H. B. Co.

The only solid rock found in the neighborhood crops out as a point near the church, and consists of a coarse-grained reddish gray porphyritic gneiss, much like some gneisses on Rainy lake. According to Dr. Bell, who has twice visited the lake,[14] it lies wholly within the Laurentian gneisses; and on this account it seemed inadvisable to put any time on its further exploration. The report of the finding of gold on Lonely lake was founded on a mistake; and according to Mr. Williams no minerals of any special value have been discovered on its shores, though specimens of pyrites, molybdenite and magnetite have been obtained in small quantities.

Rocks and minerals.

The drift deposits near the post are of much interest, forming a cut bank thirty-five or forty feet high just west of the settlement, and a series of sandy hills with some boulders to the north; but they will be described in the chapter on the glacial history of the region as a whole.

In general there is much more loose material and good soil north of the Canadian Pacific Railway than I had supposed, if the portages and lake shores on our route give a fair idea of the average character of the country. The shores are all green, the last great fire having swept through about twenty years ago, and a considerable variety of trees was observed, including

Timber, soil and climate of the district.

[14] Geol. Sur. Can., 1872-73, pp. 102 and 103; also vol. for 1886, p. 8 G.

white pine, red pine and jack pine, spruce and cedar birch, poplar and balsam poplar. Some of the pine is large enough to be of value, and the spruce and poplar would answer for pulp wood.

Its suitability for agriculture.

The soil and climate seem well adapted for the growth of vegetables. On July 15th potatoes and tomatoes were in bloom in the mission garden, and Indian corn looked thrifty, but it was a surprise to find the grasshoppers present in clouds, giving some of the vegetables a hard fight for life. The garden was surpassed however by that of the Rev. George Prewer at Wabigoon Tank, where on July 9th the early green peas were almost too ripe to eat, potatoes were about ready for use, and a field of oats was just coming into head.

There seems no reason from the geographical point of view why Ontario right up to its northern boundary should not have a summer climate suitable for agriculture. The Hudson Bay post on Lonely lake lies south of lat. 50° 30′, is only a few miles north of Winnipeg and a degree south of London, England.

The outlook for gold in the region.

Looked at as a region for prospectors, there is no probability that gold will be found in the Laurentian north of the southern end of Pelican lake, and no gold has been found north of lake Minnietakie, thirty miles northeast of the railway. Our assays prove the presence of gold at a number of points on the latter lake, though no assay went beyond $2 to the ton. Mr. Williams has found gold by panning the quartz from a small lake which we did not visit, between Minnietakie and Lonely lake. A specimen from a large vein on Muskalunge lake, south of Lonely lake, given me by Mr. Williams, gave a trace of gold when assayed. Gold has been reported from Sturgeon lake, east of Minnietakie; and may be looked for with some probability of success in any of the areas of Huronian to the north of the Canadian Pacific. Up to the present however none of these deposits have been proved to be of workable value. When as much work has been done north of the railway as on the Lake of the Woods and the Seine river to the south of it, it may well be that valuable gold properties will be developed there also.

Our return journey to Fort Frances followed the same route as we had taken in going north, so that no special mention need be made of it, except to state that some of the wider lakes were stormy enough to make the passage of our shallow built canoes very uncomfortable, if not dangerous. Fort Frances was reached on July 27th.

The Seine River Region.

Little America and

On July 27th we began our journey to the Seine river and Bad Vermilion lake, examining the two mines on the Minnesota side of Rainy lake on the way. The Little America mine, described in last year's Report,[15] was found to be shut down. Its history since the previous summer had been a checkered and on the whole unfortunate one. We found that a good boarding house and a small steam hoisting plant had been added to its equipment, and that a new shaft was being sunk, nnder the management of Mr. Whitely, the

[15] Page 53, etc.

intention being to strike the vein at a more convenient point and in a more workmanlike fashion than formerly.

The only other mine in Minnesota territory on which any important work has been done is the Lyle mine on Dryweed island, opposite the deserted "Sand Point City" on the Canadian island of the same name. We found this to be operating on bedded quartz veins in green Keewatin schist. There was no very large body of solid quartz to be seen on the surface, and we did not descend the shaft. The quartz on the dump contains pyrite, a carbonate, probably dolomite, and some black tourmaline; but we saw no free gold. Lyle mine,

We were informed that the shaft was down about one hundred feet and that fourteen men were employed, ten of them miners working in two shifts. There is an excellently equipped ten stamp mill with two Frue vanners; but this had been in use only twice in an experimental way. There were unfavorable reports as to the poverty of the ore; and if these are correct one can only feel sorry that so much energy and capital should be wasted on one of the least promising properties in the region. on the Minnesota side.

On the way to the mouth of the river Seine, the row of islands fringing the south shore of Seine bay was visited, and their white, chalky looking cliffs were found to consist of anorthosite, often displaying immense crystals of striated felspar, some of the cleavage surfaces covering nearly a square foot of surface. Anorthosite cliffs on Seine bay.

Paddling up Seine river we reached the mouth of Bad Vermilion creek, up which we turned to the lake of the same name. Many changes had been made since last year, when there was not a house in the region except Indian shanties on the reserves. There were the beginnings of clearings here and there, and an inhabited house at the mouth of the creek with a bit of garden about it, and a well providing delicious water, a most welcome refreshment on a July day with nothing but the flat and brownish river water to be had elsewhere. On Bad Vermilion lake.

On the first portage we met a party sent out by the Smithsonian Institution, with the co-operation of the Dominion government, examining into the kinds of fish inhabiting the waters. They were provided with sounding apparatus and nets for deep fishing. We were told that in Bad Vermilion lake they obtained from the cool depths some fine specimens of lake trout, which never show themselves nor take the hook in warm weather in these waters. The report of this expedition should be of great interest not only in regard to the fisheries of these lakes, but also as to their depth and other important features. An international fish expedition.

BETWEEN BAD VERMILION AND SHOAL LAKES.

At the time we visited Bad Vermilion during the previous summer no gold discoveries of any importance had been made on its shores, though a small number of locations had been taken up on Shoal lake to the southeast, including the Wiegand's veins in an area of granite not mapped by Dr. Lawson. It was decided to spend a short time visiting the locations where work of any importance had been done, and also if possible to trace the outlines of the granite and the associated anorthosite. The accompanying map Mining locations in the granite and anorthosite areas.

embodies the results of this work, which however might be made more complete by a longer and more careful study of the district. The more interesting petrographical features of this important group of eruptive rocks will be mentioned later.

At a point on the way up the creek, near a narrows where granite comes in contact with gray green schist, a small pit has been sunk, showing quartz with copper pyrites and fragments of schist, but no distinct vein was to be seen. Exploring the narrow bay to the northeast near the head of the creek, and pushing our canoe through greenish foul-smelling water of the consistency of pea soup, we found that its east shore was of granite and its western one chiefly of anorthosite. The granite touches the eastern shore of Island bay also, and then runs inland toward the north.

Veins in the anorthosite.

Since last summer the whole region has been scoured by prospectors, and almost all the land in sight has been surveyed into locations. Many locations have been taken up also to the south of Little Turtle river, and between it and the Seine above Shoal lake. It is probable that only a comparatively small number of these will prove to be of any value. Some were even located and surveyed when the snow was on the ground, and neither rock nor quartz veins were visible. Several of the properties, especially those in the anorthosite, appear to contain no large bodies of quartz, but only small irregular masses, generally associated with smaller or larger inclusions of schist in the eruptive rock. Apparently the quartz does not belong to the anorthosite in these cases, but to the schist, as one would expect in so basic a rock. The owners of these pockets of quartz speak of the vein as "capped over," and consider them important, though only "surface croppings," since they are "sure to widen as they go down."

Some of these small pockets of quartz contain copper pyrites and other sulphides and probably carry some gold, but the only specimen of such quartz from the anorthosite which was assayed yielded no gold. At one or two points what is apparently a vein of schist or "slate," without quartz, occurs in the anorthosite and strange to say may carry gold, according to Mr. W. E. Stone, a prospector in the region. He states that one band of schist gives colors in the pan, and a specimen which he showed me contained a small speck of gold. So far as the evidence goes however the anorthosite appears to be completely barren, except where it has caught up inclusions of the surrounding more or less auriferous schists, and the locations taken up on this rock are not likely to be of value.

Veins in the granite.

On the other hand, many of the locations on the eastern area of granite and some of those in the green schists to the east of this look very promising.

A day was spent in visiting some of the more important of them, going inland by a road cut from Island bay and running to Shoal lake.

Campbell's location.

The Campbell property, AD2, lying some distance north of the road, was visited first, and several veins in the granite were examined. One, which has a strike of 100 degrees, can be traced for a considerable distance with slaty walls. The quartz contains sulphides and looks well. Another striking northeast and southwest sometimes divides into four or five parts, in all eight feet wide including partings of rock matter.

A little further north the granite touches the green schist, some of which is in reality a coarse conglomerate, well seen on top of the highest hill in the region. In the green schist, or perhaps rather fine grained diabase, also veins occur, as at Randolf's location, where a vein four or five feet wide runs northwest and southeast. Randolf's location.

Turning south again, one of Kelley's locations, AL111, which is within the granite, was examined. A vein six inches wide, with a strike of 100 degrees, contains considerable free gold associated with the usual sulphides, pyrite, zincblende and galena, in whitish quartz. Another of his veins having a similar strike is two or three feet wide, and a third, which cannot be traced very far, contains a quantity of sulphides. Kelly's locations.

Finally the Lucky Coon or Hillier mine, 655P, was visited. It was at that time the property of Messrs. Campbell, Robertson, Mosher, Hillier, Steele and Miller; but according to newspaper reports it has since been sold to English capitalists. Here two veins had been somewhat worked, No. 1, which strikes about 135°, to a depth of twenty feet; No. 2, which strikes 110° and dips a few degrees to the southwest, is about four feet wide at the top, and eight feet eight inches at one point at the bottom of the shaft, which had been sunk fifty feet. There are several other quite large veins on which no work had been done, all in the granite. The quartz from the shaft is reddish and more or less charged with sulphides, and looks very well. Lucky Coon or Hillier mine and mill.

A small five-stamp mill was erected on this property, at that time the only mill in the region, but owing to disagreements between the owners it was not working. The mill was unprovided with a vanner, so that no concentrates were saved, apparently a wasteful state of affairs in working an ore containing so much sulphide. I was informed that the mill had run only twenty days, treating on the average fifteen tons in twenty-four hours. The average contents of gold per ton of ore were said to amount to $28 to $30, of which perhaps $8 was free milling, while the rest was supposed to pass off with the sulphides. Some of the tailings obtained at the mine, perhaps not an average sample, were assayed in the laboratory of the School of Science, Toronto, and proved to contain only a slight trace of gold per ton.

Turning south again we descended Bad Vermilion creek and then turned east into Shoal lake, which we found greatly changed since last year, when a tent and a bark canoe were the only sign of life visible. Now on turning into the lake we were passed by a bustling little steamer and saw before us the half-dozen houses of Seine River City, the metropolis of the new gold region, while in the blue distance stood the group of buildings at Mine Center, near the other end of the lake. Signs of activity on Shoal lake.

Here some time was spent in examining the original Wiegand locations, probably the best looking properties in the region. We found that a number of veins in the granite had been stripped and several small shafts and openings made, but no real mining had been done. The Weigand Brothers' locations.

The Wiegand Brothers have disposed of several of their properties, AL 74, 75 and 76, which are now owned by Mr. Foley. Under the new owner- Promising prospects on AL 74, 75 and 76.

ship there is every prospect that the property will be fully tested and the question will finally be settled as to the depth and value of the gold bearing veins. At the time of our visit a good road was being cut from the lake half a mile inland to the camp, and it was intended to sink deep enough on some of the veins to make sure of an ore supply before spending money on a mill, thus most wisely reversing the usual unbusinesslike procedure in western Ontario. No mining was being done on August 2nd, nor had any of the openings been sunk to any great depth, but according to newspaper reports shafts have since been sunk to two hundred feet on one vein and over one hundred feet on another, with the result of proving the presence of a sufficient body of ore to warrant erecting a mill.

Two views of the granite masses.

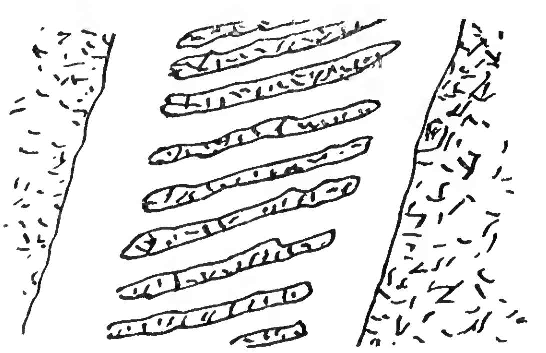
Last summer the opinion that these veins in the granite might prove to pinch out rapidly in depth seemed to be somewhat prevalent, some thinking that the granite is only a flat, thin sheet spread over the green schist or conglomerate. There seems no good reason however for this conclusion. Such areas of granite are not to be looked on as laccolites, or lenticular masses squeezed in between the layers of schist, but as broad based masses of unknown depth, probably widening as they go down. If the latter view is correct there is no reason for doubting that some of these true fissure veins, which have been traced for long distances between well-defined walls on the surface, should not go down to very great depths, still remaining within the granite.

Varying character of the ores.

The ore varies greatly in different veins at no great distance apart. At one of the dumps on the Foley property we found rather white quartz with only a small quantity of sulphides visible, but almost every other fragment contained specks of free gold. This ore should be quite free milling. At another opening however, on AL 74, where a shaft had been sunk to a depth of thirty one feet, the ore is of a very refractory kind, containing much zincblende, iron pyrites and copper pyrites and a little galena ; so that the treatment advisable for the ore from one vein may be quite inapplicable to that from another.

Formation of some large veins.

Several other veins in the neighborhood were examined, one on AL 104 being nine feet wide in places and tracable three eighths of a mile, though the quartz is not as promising as in some smaller veins. A singular structure may be seen on some parts of this vein, the edges being of solid quartz, but the interior largely made up of strips of granite drawn out in a diagonal way and separated by bands of quartz.



Vein of quartz in granite, showing granite drawn out diagonally in centre of vein. Shoal lake, AL 104.

Some of the larger veins have the quartz more or less sharply divided into bands parallel to the walls, probably because the fissure has been widened at successive times, each time having a band of quartz deposited in the fresh space.

The modified granite, or protogine.

In almost every case the granite, which is coarse grained and a typical granite, flesh-colored, and with black

mica in unaltered parts, becomes modified into a greenish, chloritic granite, the so-called protogine, near the vein; and at its very edge is changed into a greenish schistose rock consisting of quartz grains and chlorite or sericite, but almost entirely free from felspar. This band of modified granite probably results from a shearing motion which had ground down the softer minerals, when the fissure, no doubt accompanied by faulting, was formed. The circulation of hot water in the fissure probably completed the change of the crushed felspar in sericite masses. The characters of these rocks have been described by Winchell and Grant, and their work was quoted from in the last volume of this report.[16] As the general features of the granite and the veins which it contains were described in the previous report, little need be said of them here.[17] It may be remarked however that the gold of the Shoal lake region impressed me as being rather pale in color and usually in very fine particles as compared with the coarse, yellow gold of the Lake of the Woods.

At the time of our visit everything was very quiet in the region, the shutting down of the Lucky Coon mine having had a very discouraging effect; but judging by later reports as to the working of a location under the energetic direction of Mr. Whitely and of the satisfactory results of the shafts on the Foley properties it is probable that the region will soon be thoroughly tested. I am still of the opinion that this district has good prospects as a gold mining region, though many of the prospectors who rushed in and seized on every unoccupied part of the granite area without reference to the finding of distinct veins will probably make nothing for their trouble. Some of them underwent great hardships. One Australian prospector, beside whom we camped on a picturesque rocky hillside on Bad Vermilion lake, gave us a vivid account of how he and his young son passed the previous winter in their small tent, facing weather in which the mercury was frozen. Several of the earlier prospectors however have made sales, in which at least part of the payment was in cash, and will not go empty handed; but as usual the larger rewards will probably fall to the lot of those with more capital.

Prospects of the region.

It is worthy of mention that a good deal of fairly good land may be seen on some of the locations and along the Seine river, and a considerable area of excellent land occurs near the Little Turtle river, so that agriculture may add to the resources of the region, the mining community furnishing an excellent market for any produce.

Agricultural lands.

BETWEEN LITTLE TURTLE RIVER AND THE SEINE.

Many locations have been taken up in the Keewatin schists between Little Turtle river and the Seine, some of them on Timber Berth No. 34, where difficulties have arisen as to titles. The only properties visited by us were those of Bull, Price & Co., which lie a mile or two north of the narrows between Shoal and Wild Potato lakes. Here there are several veins, usually of a bedded character in a very cleavable talc or sericite schist or slate, having

Locations on Timber Berth No. 34.

[16] Prelim. Rep. on Rainy Lake Gold Region, Nat. Hist. Sur. Mich. 23rd An. Rep., 1894, p. 58, etc.

[17] Fourth Rep. Bur. Mines, 1894, p. 55, etc.

a strike of about seventy degrees. The rock itself contains pyrite, and the quartz affords rich samples of free gold. Several short narrow veins on JO13 show a large amount of free gold on the surface, but have not been sunk upon at all. The veins appear to be in the talcose or sericitic rocks, and not in the green schist which extends between them and the river. Few of the veins appear to cut decisively across the strike of the country rock or to have distinct walls, but several of them appear rich enough to be of value.

It is reported that native copper has been found on JO13 with the gold ores, but the gentlemen who took us over the property were unable to find a piece to show us.

It should be noted that the small cross veins are generally very much richer in gold than the wider quartz lenses of the bedded veins.

THE SEINE, FROM SHOAL LAKE TO STEEP ROCK LAKE.

A variety of striking river scenery.

Above Shoal lake the river Seine narrows for a mile or two and then widens into Wild Potato lake, where there is an Indian reserve, narrowing again for a stretch of about six miles, when steamboat navigation ends at the pretty Sturgeon falls. Above this there is a succession of short stretches of more or less calm water, interrupted by small falls or rapids, a troublesome journey in a canoe from the constant short, rocky portages, often with very rugged and slippery paths ; but full of most beautiful scenery, the yellowish white foam contrasting with the dark brown and amber water and grim rock walls, with wild, unburnt forest as a setting. The variety is very striking. A reach of quiet river with no rock in sight, but reed-margined and so absolutely still that the reflection of the forest is perfect except where the canoes ripple the surface is followed by a tumultuous current up which the canoes must be padded or poled with all one's strength among great boulders or jagged edges of rock, until at last the thunder and foam of a water fall compel one to land and seek the portage.

Rapids and falls from Sturgeon falls to Calm lake.

Including Sturgeon falls, at the head of navigation, there are thirteen rapids or falls past which one must portage in order to reach Calm lake, or Nonwatin lake, as it is named on the map of the Geological Survey, a distance of only twelve miles, the ascent being in all a hundred and twenty-five feet as determined by aneroid. For most of the distance the rocks exposed on the portage are green Huronian schists, sometimes containing small quartz veins. During the latter part of the journey, where the river flows south, it crosses the strike of the schists, and here the rapids have a special character ; each being very short and formed by a sort of dam of the steeply dipping schist. Where the rapids occur in granite, which has more rounded forms, there is apt to be more variety and a greater length of white water.

Calm lake.

Calm or Nonwatin lake is enclosed at each end in Huronian schist and porphyry, but a band of Laurentian crosses its center. It is a beautiful lake, with green hilly shores, rocky promontories and curves of yellow sand beach in the bays. No locations have been taken up on Calm lake, but a number have

been in the country between this and Sturgeon falls. None of them appear to have been developed sufficiently to make it worth while to visit them.

Calm lake to Harold mine.

Leaving Calm lake one finds that the river resumes its character with swift currents, rapids and placid lake expansions, the rock when exposed being sericitic or chloritic Huronian schist and slate. After an archipelago one enters Perch lake. Eye river comes in from the north at the upper end of this lake, and a few miles to the east there is a bay on the north from which Harold lake may be reached.

At several places along the part of the Seine between Sturgeon falls and this point there are drift deposits of angular or rounded pebbles and boulders, generally of Laurentian rock, but no wide stretches of rich alluvial clay as on the river below Sturgeon falls.

HAROLD LAKE GOLD LOCATIONS.

Mine and mill on the lake.

Harold lake may be reached either by paddling up a weedy, narrow stream and crossing a small lake and short portage, or by a trail a mile or more in length across the somewhat boggy and rocky country. Here a number of veins have been discovered and partially developed by the enterprising Wiley Brothers of Port Arthur; and a winter road has been made by the Ontario Government from Bonheur station on the Canadian Pacific Railway to the location, so that the heavy machinery for a stamp mill might be brought in. At the time of our visit (August 7th), the mill, which is of five stamps, from Fraser and Chalmers' works, with a Gates crusher, had been running for three or four days, in charge of Mr. Peters, but no clean-up had been made. Since then however a number of gold bricks have been turned out and the property put in good working order. Four houses had been built, a small steam saw mill being used to cut the lumber, and sixteen men were employed. The hoisting was done by horsepower.

Granite masses in Huronian schists.

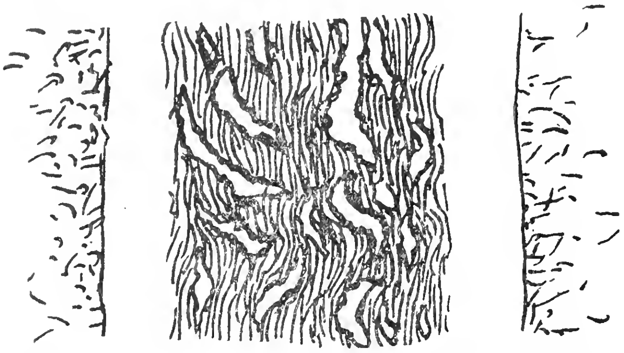
Geologically the surroundings are interesting, the country rock consisting of various yellow and green schists, pierced by small eruptive masses or bands of granite or protogine, as the rock may be called, since mica is partly replaced by talc or sericite.

Occurrence and character of the quartz veins.

All of these rocks are much disturbed and badly weathered, the granite showing the shattered quartz fragments resulting from crushing. Some of the veins occur in the granite itself or at its contact with the schist, and others entirely in the schist. The latter rock varies much in character, some parts being sericite schists, much weathered, while another portion of the country rock consists of an intimate mixture of quartz and dolomite. Close to one of the veins the granite has been changed into a shaly material, forming a good wall, while at another vein the country rock, a schist, is yellow and friable as if attacked by acid fumes. The veins themselves are not very wide, the widest measured reaching about two feet and a half feet, but some portions of the quartz, especially from a vein exposed on the cliff at the lake shore, show a good deal of free gold. In the latter instance a number of tons of very rich looking ore were obtained by draining off the lake for a few feet and gathering up the quartz boulders. Some of the quartz is heavily

charged with sulphides, pyrite, chalcopyrite and galena; other parts are very cellular, from the weathering out of pyrite. In the protogine granite forming the walls of the veins there are frequently sulphides bearing gold, and it is not impossible that the eruptive granite masses are the source of the gold, as they appear to be on Shoal lake and some parts of the Lake of the Woods. These quartz veins vary much in strike, some running nearly north and south, and others nearly east and west. The dip varies from vertical to 60° or 70°.

A very singular vein, apparently not auriferous, occurs in the granite near the camp, having from a foot to a foot and a half of quartz against each wall, but the center formed of two or three feet of crumpled green schist charged with small knobs and veins of quartz. It is possible that the strip of schist has been carried off by the molten granite and after cooling formed lines of weakness on each side where fissures formed and were filled with quartz.



Granite. Quartz. Schist. Quartz. Granite.

Vein of crumpled green schist between bands of white quartz in granite. Lake Harold.

Sawbill lake gold location.

After our arrival at Port Arthur, one of the Messrs. Wiley gave me several very rich specimens of quartz from a vein on Sawbill lake, nearer to the Canadian Pacific, and said to come from larger and more continuous veins than those of Harold lake. I am informed that they intend to put a stampmill on this property also. Neither of my maps show this lake, but the property must lie in or near the strip of green Keewatin schist stretching from Harold lake northeasterly toward the railway. As its discovery had not been reported when we passed through, we had no opportunity to visit the locality.

Rich ores from Harold and Sawbill lakes.

An assay was made of a specimen from the Harold lake property, giving $108 in gold and three ounces of silver. This specimen was taken by myself and showed no free gold, but was undoubtedly much richer than the average ore. An assay of material from Sawbill lake, given me by Mr. Wiley, yielded $170 in gold, but was evidently a picked sample.

STEEP ROCK LAKE.

Unique shape and picturesque appearance of the lake.

Following up the river Seine to the east of the Harold lake trail, one comes after a mile or two of paddling broken by two portgages to Steep Rock lake, a beautiful but tortuous sheet of water having something the shape of a capital M. The Seine river coming from the northeast enters it, after a fine waterfall, near the north of the second angle of the M; while Atik-okan river joins it through widespread marshes at the southern end of the first stroke of the M. The lake is well named, for bold cliffs rise at many points, sometimes to the height of one or two hundred feet; and since the rocks have great variety of color, white, reddish brown and green, the effect is very picturesque.

Geologically the shores of this lake are much more interesting and complicated than those of any other in the region ; since limestone, conglomerate, green schist and granite with dykes of greenstone are found strangely mingled. Groups of rocks on the shores of the lake.

The geology has been worked out somewhat elaborately by Mr. Henry Lloyd Smith [18] who visited it in 1891. The map of the Canadian Geological Survey does not give the details of the geology of the lake, probably because of its small scale.

Mr. Smyth distinguishes three principal groups of rocks on the shores of the lake, a basement complex, a Steep Rock lake series, and an Atik-okan series. According to Mr. Smyth the basement complex consists of granites and gneisses older than the other rocks ; while the Steep Rock lake series resting upon it has no less than nine well marked and persistent horizons, including conglomerates, limestones, schists and interbedded traps ; all bent into a horizontal sigmoid fold out of which most of the lake bed has been sculptured. The Atik-okan series consists of later granite porphyries and massive hornblende rocks.[19] The Basement complex is no doubt equivalent to what is generally called the Laurentian ; while portions of the Steep Rock series resemble Lawson's Keewatin ; though the limestones and conglomerates or breccias with a calcareous and ferruginous cement differ totally from any Keewatin rocks observed elsewhere by myself. The Atik-okan series seems to be partly Laurentian, using the word in a lithological sense rather than a historical one, and partly Keewatin or Huronian. Lloyd Smyth's classification stated and reviewed.

According to Mr. Smyth, the relationships of the three series of rocks are complicated by several faults as well as the folding mentioned.

Our observations, which were made rather hurriedly and before I was acquainted with Mr. Smyth's work, correspond very well with his as shown on the map accompanying his paper. We found the shores to consist chiefly of green schistose rocks or of granite, except at the two upper points of the M, and here and there along the northeast shore of the last down stroke of the M, where limestone and conglomerate with calcite were found. The map of the Geological Survey represents a tongue of Huronian as running along the northeast side of the second down stroke of the M ; but my observations prove that much of that shore consists of a whitish granite or protogine, though some small promontories consist of limestone. Probably the soft and easily weathered ferruginous limestone has been excavated to form part if not all of the lake bed. Green schists, granite, limestone and conglomerate.

A number of iron locations have been taken up along the lake, but the only indications of the ore which we saw were the rusty weathering of some of the impure limestone and a stretch of sand containing much brown hematite along the shore of the bay south of Elbow point, the central downward bend of the M. The limestone, parts of which are probably pure enough for lime burning, may prove of considerable importance if the region as a whole fills up, since this important rock is found in very few and limited areas between the Lake of the Woods and Port Arthur Iron ore and

[18] Am. Jour. Science, vol. XIII, Third Series, 1891, pp. 317-331.
[19] Ibid., p. 319.

limestone

Since the greenish granite and its schistose modification are very much like the eruptive masses containing gold bearing veins at Harold lake a short distance away, as well as at Shoal and other lakes to the west, it would be worth while to see if this too does not contain quartz veins. The great dislocations and flexures reported by Mr. Smyth must have occasioned much fissuring, and thus have given a chance for the formation of veins.

A locality worth prospecting for gold.

From the southeastern extremity of the last narrow reach of Steep Rock lake there is a rough, precipitous portage into a small sheet of water, Margaret lake, sixty feet higher up, according to our aneroid, and another rough portage into a second, still tinier lakelet, the whole ascent amounting to about a hundred feet. Both lakes are bordered with coarse white granite containing bands of green schist, or perhaps dykes of diabase.

The portage from Steep Rock lake to Atik-okan river.

Fire has swept this part of the region, and the blackened tree trunks against the white and rugged granite make a wild enough scene. Many of the hollows between the granite ridges are largely filled with great angular or somewhat rounded boulders of the same rock, sometimes mixed with a little clay. No doubt the advancing glaciers pushed this debris into the lee of the more resistant knolls and ridges of rock.

From the southernmost lake there is a third of a mile's portage across the bare ribs of Huronian schist to the Atikokan. Just before this river is reached there is the most reckless descent down unclothed rock cliffs over which I have had the misfortune to portage. The canoes almost stood on their head going down, and great care had to be taken in picking one's steps not to get a bad fall for man and canoe.

It is said, however, that the river has such interminable windings, shoals and rapids between this point and its entry into Steep Rock lake that time and trouble are saved by following the crooked lake and scaling the three terrible portages. We found the drop between the last lake and the Atik okan to be forty-five or fifty feet.

From the Atik-okan to Lac des Mille Lacs.

Character of Atik-okan river.

Following up the Atik-okan, or Reindeer Bone,[20] as the name is translated, one finds that it is a stream having a decided character of its own. It is generally called a river, but had no claim to the title during my two visits to its waters, since in many parts it was scarcely deep enough to float our light-built canoes.

There is a short, steep portage over Huronian schist past a pretty fall soon after embarking on the creek, and this is followed by shallow, grassy stretches with considerable current, here and there interrupted by "riffles," or short rapids, up which the canoe must often be poled or dragged. Most of these rapids are over boulders, not solid rock, and much of the bottom of this part of the creek is of small, rounded boulders. Where the bottom is sandy or muddy, long trailing plants with thread-like leaves form a sort of

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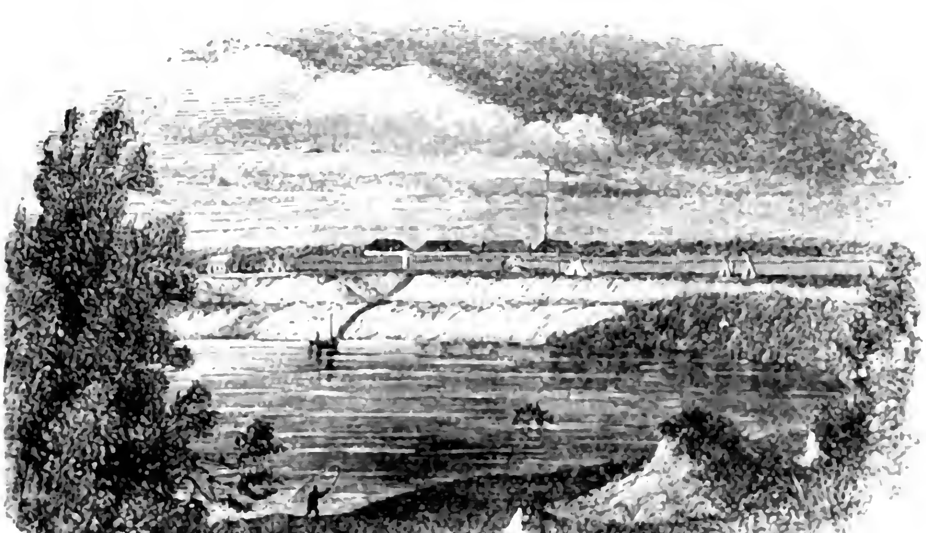
[20]Atik = reindeer, and okan = his bone, according to Barraga. By some it is translated reindeer horn, but the Chippewa name for horn is eshkan.

Eighth Falls up Seine river, p. 68. From a sketch in Indian ink by Dr. A. P. Coleman.



Fort Frances in 1857, p. 161. Reproduced from a sketch by H. Y. Hind.

Falls on Atik-okan river below Magnetic lake, p. 141. From a photograph by Dr. Robert Bell

Iron Mountain on Atik-okan river, p. 141 From a photograph by Dr. Robert Bell

carpet of wavy green mermaid's hair, tangling the paddles and encroaching on the depth of water needed for the canoes.

Most of the shore as far as Sabawe lake was swept by fire last year and is now desolate enough.

Iron locations on the river.

Along this part of the river and beyond Sabawe as far as Whiskey Jack lake the Huronian (Keewatin) schists contain more or less magnetite, and sometimes display ruddy brown walls of iron-stained rock at a little distance from the shore, but the immediate shore is generally swampy. Most of the north shore and some of the south has been taken up as iron claims; but nothing further need be added to the description given in last year's report.[21]

The Sabawe and Magnetic lake sections.

Sabawe lake, unlike many others in the region, is dammed by loose materials, and two-thirds of the way up is almost cut in two by a long spit of sand. Below this its waters, like those of the river, are brown and rather turbid; but above it they become clear. Between Sabawe and Magnetic lake the valley is wide and flat, consisting chiefly of muskeg and marsh, with a few islands of Huronian rock rising above the general level; and the low banks of the creek are of clay, proving that the whole was once a lake, now almost wholly silted up. A little further lowering of the drainage level would provide wide flats of most fertile soil.

A break in the Huronian tract on Whiskey Jack lake.

At the entrance to the narrow expansion of the Atik-okan, named from a well known bird of the northern forests Whiskey Jack lake, one finds a reddish gray rock which turns out to be augite syenite or syenite gneiss, apparently Laurentian, and granitic-looking rock is to be seen wherever rock is exposed on the shore of the lake; so that a small area of Laurentian or perhaps of eruptive granite rock here interrupts the Huronian.

Through lakes and across portages into a Laurentian region.

On the rather long and steep portage by which Magnetic lake is reached the rock is again Huronian, and its shores and those of Crooked Pine lake seem to be of the same character, though on the southeast side of the latter small rounded granite boulders appear on a strip of sandy beach.

A short portage south from Crooked Pine lake crosses the watershed between the system of waters flowing into the Seine, and after a small and apparently nameless lake, another portage leads south to Elbow lake, whose southern end lies within the Laurentian. Once more there are two portages with a small lake between, leading to lake Windigoostigwan. The first or more northerly of these two portages, though not long, is over very bouldery ground, and huge perched blocks of granite stand out against the sky on the bare, fire-swept ridges of Laurentian rock. The more southerly portage is perhaps half a mile long, at first up a steep clay bank excessively slippery in the rainy weather we encountered; afterwards over rich looking soil or great boulders, with Laurentian rocks showing here and there.

Following the Dawson route to Savanne.

From this point we followed the old Dawson route, portaging into Baril lake and then into the southwest arm of Lac des Mille Lacs. As the whole distance is apparently through Laurentian rocks, and as the time allowed for the trip was nearly up, we made what haste we could and did not delay for geological work.

[21] Fourth Report Bureau of Mines, p. 75.

Half way up Lac des Mille Lacs however we were wind-bound for a day and were obliged to camp on a long point of drift material on the north shore. Savanne was reached on August 12th.

From Savanne a telegram was sent to Mr. Blue, Director of the Bureau of Mines, who had reached Fort William on the way to join us for the remainder of the summer's travel. A day or two of delay gave an opportunity to visit the Indian village on Poplar Point, ten or eleven miles from the station at Savanne. As this village was afterwards visited by Mr. Blue, who will report on the general features of the country traversed on his way to Fort Frances, it will be unnecessary to do more here than to refer to some geological points. The whole region about Savanne is a great muskeg, or peat bog, more or less covered with stunted spruce, but showing no outcrops of rock along Savanne river. Just beyond the mouth of the river, which enters Lac des Mille Lacs two or three miles below the station of the Canadian Pacific Railway, granite and gneiss show themselves; but Sand Point, to the southwest, as its name indicates, is formed of drift. Cliffs of stratified crossbedded sand rise twenty or twenty-five feet above the lake, sometimes accompanied by pebbles and boulders, the whole consisting probably of glacial materials rearranged by the waters of a deeper lake than the present one. No polished or scratched boulders suggesting unworn rock fragments brought by direct glacial action were seen. Among the pebbles were chips of jasper much like some collected earlier in the summer at the Hudson Bay post on Lonely lake.

Geology of the region about Savanne.

On the face of the sand cliff, two and a half feet below the top, a bone was seen projecting at one point, and a little digging disclosed a tolerably complete Indian skeleton. With it were found fragments of a well made earthen pot with some red ochre, but no arrowheads nor axes. The body had probably been buried in a sitting posture, since the skull rested on the ribs and leg bones. A hole in the skull perhaps indicates a violent death.

Aboriginal remains.

Round Lake and the Huronian Mine.

On August 14, having been joined by Mr. Blue, we set out for a visit to the Huronian mine, engaging a guide at Savanne, since neither of our half-breeds had been over the route. A large bark canoe was secured to carry the addition to the party.

Savanne to lake Shebandowan.

Against strong head winds and a very disagreeable sea we made our way south on Lac des Mille Lacs to the foot of its large southeastern bay, where a mile's portage over an unusually good road leads across the watershed to Kashabowie lake, which empties by a short river with numerous falls into lake Shebandowan.

At the last island to the south of Lac des Milles Lacs we found that the Laurentian rock, forming most of the shore of this lake, gave way to a Huronian conglomerate, and Huronian schists show themselves at the north end of the portage. On a small lake to the south and from that to a point near the south end of Kashabowie lake we saw nothing but Laurentian

granite and gneiss. Near the foot of this lake there is a breccia of gigantic gneiss blocks cemented by strips of granite.

There is another long portage between Kashabowie lake and lake Shebandowan, and on camping at its southern end we were fortunate enough to find Mr. James Hammond's exploring party, now on its way home after a hard summer's work to the south and west of this point. Probably no one is better acquainted with the region than Mr. Hammond, and Mr. Blue and I were much pleased to have him serve as guide in the two short expeditions which we made, one to the Huronian mine, the other to the iron deposits of Greenwater lake and the Mattawin river.

As these expeditions promised to be somewhat arduous it was decided that a portion of the party should remain in camp at the southern end of the portage, while Mr. Blue, Mr. Burwash and the writer with Mr. Hammond and three canoemen should push on to the Huronian mine.

As it is Mr. Blue's intention to describe the routes followed, it will be necessary here to touch on the geological and mineralogical features of the country only.

Owing to the limited time left for the visit to the Huronian mine no detailed observations were made on the southwestern end of lake Shebandowan, though rock having the appearance of Huronian was observed on the way; nor was there any delay in crossing the portages and small lakes between Shebandowan and Round lake. On the shores of the latter lake a number of locations have been taken up and a few hours were employed in visiting and examining some of these.

MINING LOCATIONS AT ROUND LAKE.

A fahlband of Huronian schist east of the lake.

Just east of Round lake is the Tip Top mine, K65 and adjoining locations, in which Mr. Hammond and others are interested. Where we visited it the deposit may be described as an extensive fahlband in the Huronian schist, having a width varying from one hundred to five hundred feet, and extending for perhaps half a mile. On each side of this great mineralized bed one finds green Huronian rock, sometimes containing a little pyrite. Near the green schist the much decayed rock of the bed, partly talcose and partly a green rock like graywacke, is heavily charged with sulphides, iron pyrites, copper pyrites and some pyrrhotite; the copper pyrites sometimes in nearly solid beds. The central part of the great bed consists partly of bluish quartz with some pyrites, and also a green silicate. These minerals are sometimes associated with what seems a fine grained eruptive rock, perhaps gabbro. Samples of the sulphides and also the green silicate are reported to have been assayed by Dr. Goodwin and Messrs. Hille and Hayes, and to have contained some nickel (less than one per cent.) and a little cobalt; as well as gold from nothing up to $4.00 per ton. An assay of the green silicate made in the laboratory of the School of Science, Toronto, gave no evidence that nickel is present.

The copper contents of this great fahlband should pay well to work when there is better communication with the world.

Gold-bearing porphyritic rock on the northwest shore of the lake.

The shore of Round lake at the end of the portage sweeps as a long curve of sandy beach; but a point to the northeast consists of gray porphyrite, and a bay stretching to the north is said by Mr. Hammond to lie in the granite. On the northwest shore of the lake several locations have been taken up on a large eruptive mass rising steeply out of the water into rounded hills. Very stormy weather and the shortness of the time at our disposal made it impossible to do more than examine a few points on the shore of this eruptive mass. It had been described as quartzite, but of the several specimens of the rock taken by myself, some pale greenish, others purplish, none turn out to consist of quartz. The freshest specimen, from R559, is a well defined quartz porphyry, while the others are felsitic in look and are probably sheared porphyries. They are all more or less impregnated with pyrite and chalcopyrite; and at some points a little fluorite is found.

Assays of this material, made by Mr. Hille of Port Arthur, give gold from nothing up to $7 per ton. One assay yielded half an ounce of platinum and eleven ounces of silver, with no gold. Three specimens of rock taken by myself from the shore, without selection of the most promising portions, were assayed in the laboratory of the School of Science and yielded from a slight trace up to $2 per ton of gold. No platinum was obtained. If this immense body of rock should prove to contain even three or four dollars per ton of gold on the average, it should be capable of being worked at a profit, since the rock can be quarried in unlimited quantities.

The southwest shore.

The point on the southeast side of Round lake was found to be grayish green Huronian schist, with a strike of 50°, so that the porphyry and porphyrite on the northern side of the lake appear to be between the green schist and the granite.

Cross lake and Jackfish lake.

The next body of water is Cross lake, which has altered quartz porphyry and felsite or sericite schist on its northeast shores, with a strike of 40°; and flesh red Laurentian rock at the southwest end. Similar red granite or gneiss is found on Jackfish lake, where the road runs west to the Huronian mine.

THE HURONIAN MINE LOCATION.

Country rock and ore of the mine.

The rocks observed at the Huronian mine itself are talcose slate, chlorite schist and altered porphyries. These rocks are sometimes charged with sulphides, and contain stringers of quartz five or six inches wide containing galena and copper pyrites.

There are two shaft houses beside a ravine, a mill fitted with rock breaker ten stamps and three Frue vanners; there are in store materials such as common and fire bricks, carboys of acid, barrels of salt and manganese dioxide evidently intended for a chlorination plant.

Organization of the company.

The company was first organized under the name of the Jackfish Lake Mining Company, under the Ontario Joint Stock Companies' Letters Patent Act, 1874, and the patent of incorporation being dated the 22nd of May 1875. The capital was $600,000, in 60,000 shares of $10 each, and all the shares were reported as fully paid up. The directors were: William Be

Frue of Detroit, president; J. J. Vickers, of Toronto, vice-president; John McIntyre of Fort William, and A. J. Cattanach of Toronto, with Nicol Kingsmill of the same city as secretary treasurer.

The following description of the property was given in a report by Walter McDermott, formerly assayer of the Silver Mining Co. of Silver Islet:

"In the winter of 1872-73, in company with Captain Frue, I visited the Jackfish location, which is situated about 85 miles west of Thunder bay, lake Superior.

Walter McDermott's report on the location.

"The gold-bearing vein, on which some little work had then been done, is situated on one side of and running parallel with a narrow valley formed by walls of granite on the one hand and greenstone on the other. The vein itself rests on the granite wall, but with an interposing thin belt of talcose slate preventing actual contact. For several hundred feet on both sides of the principal working the vein has been traced, but as the period of my visit was mid-winter, with its customary heavy covering of snow, my personal observations were confined to the points at which work was actually in progress. At different points of the principal opening the vein varied in width from two to seven feet, and consisted of quartz with occasional patches of yellow magnesian spar. The minerals contained in the gangue were principally copper and iron pyrites, light-coloured zincblende, galena, and with varying small proportions of free gold and sylvanite (telluride of gold and silver). The sulphurets appeared from a number of assays to carry always a small though variable quantity of both silver and gold, the two metals maintaining a pretty constant relative ratio; and occasional streaks of the mixed sulphurets, differing but very slightly in appearance from the bulk of the mineral, yielded quite richly on assays. The occurence of the free gold and sylvanite, generally though not always in conjunction, was irregular but not infrequent, for during the three days I remained on the spot several separate blasts developed rich portions of the vein from which many very fine specimens were obtained, showing free gold in strings, spangles and small nuggets and streaks, coatings and small masses of the extremely valuable sylvanite ore. This sylvanite was first mistaken by the miners for silver glance, but assays and analyses proved it to be the true telluride of gold and silver, some samples of the sulphurets through which it was mixed yielding on assay up to $4,000 per ton in gold and silver, chiefly the former. From some few barrels of the ore taken to Silver Islet, 123 lb. of rock was selected and sent to Balbach's smelting works in New Jersey, the works returning as a result a small brick of silver and button of gold, weighing respectively 5½ and 1.16 oz. Of course it is not to be supposed that so high a result represents the average of the rock; nor does it any more represent the best that could be obtained, since a little more rigorous selection of the sample sent could easily have made the latter yield double or quadruple the percentage of gold and silver, as any person will understand when it is understood that many samples could be selected carrying free gold alone, or with the rich sylvanite.

Metallic constituents of the gangue.

"A road has been cut through the woods a distance of 12 miles, and connecting the mine with lake Shebandowan, and thereby with the Red River

road to Thunder bay, the route of the Pacific railroad branch at present in process of construction. The immediate neighborhood of the mine is heavily timbered, the trees being of good growth and various qualities, offering everything in the way of timber supply for mining purposes. The occurrence of the soft talcose slate on a hard wall is very favourable for the breaking out of the vein, and leaving a good wall requiring hardly any timbering."

John W. Plummer, now a well known mining engineer in the western States, made the following report to Mr. Frue under date of 20th October, 1875 :

John W. Plummer's report.

"I beg to hand you a short report of our explorations at the height-of-land gold properties, showing the result and extent of our operations at Jackfish lake location, or H1. Taking this location as our starting point, my attention was directed to a vein situate about the centre of the location, on which some work had been performed. This vein, which is the chief of those discovered, is from three to four feet wide, composed of lead and copper in a gangue of quartz, with well defined walls lined with talcose slate. Its bearing is about N. 50° E. The opening on the vein at this point by former explorers yielded a quantity of native gold. We put in several blasts, nearly all of which yielded free gold. The vein is traced with ease to the southwesterly limit of the location. At an opening made some 20 chains from the first the vein shows itself moderately rich in copper and lead, but no visible gold. In the northeast end of this location the vein is divided, but such portions as were found were full of mineral. By developing this property at the first opening the divided portions of the vein can be traced with greater accuracy, and with every prospect of success.

Huronian mine.

Highland mine.

"Highland Mining Company, or H2. This location lies to the southwest of H1. The vein passes through the whole of its length diagonally. Several openings have been made. A quantity of iron pyrites is now seen in the vein, associated with a small quantity of copper and lead. No free gold is visible; but samples from various pits, both here and elsewhere on the vein, showed when assayed gold in more or less quantities.

Neebish mine.

"Neebish Mining Co, or H3. This location lies to the northeast of H1. The vein, which carries itself so well through H2 and a portion of H1, is here hard to find, and is apparently divided into smaller branches, which will unite probably in depth, or some point further to the northeast.

Shebandowan locations.

"Shebandowan Gold Mining Company's property. This property includes locations lying to the northeast and southwest of H1, 2 and 3. Those lying to the extreme northeast I did not examine, my time being occupied in tracing the Jackfish vein through the southwest lots; and starting from the southwest limit of H2 the vein is traceable for a long distance, some two miles. It appears at every opening much the same as on H2 (auriferous quartz, small quantities of iron pyrites, copper and lead). This vein is exceedingly uniform in all its peculiarities throughout its length. On H8 and H7 two other veins were discovered, one on each side of the main vein and parallel to it. One of these veins is pretty well defined; the other irregular and massive. Several small branches and veins have also been found both in this and the other properties.

"I think on the whole our explorations have been to a certain extent satisfactory. They have proved the existence of a vein of great length and vitality, carrying throughout more or less gold, visible and invisible. It also proves the existence of other veins which, under development, might prove as rich if not richer than those already opened. General conditions.

"The facilities for working are pretty favourable. Large belts of timber can be obtained quite close along the course of the vein; water for concentrating and other purposes can be obtained at a small expense; and communication with the Canadian Pacific Railway (according to their present programme) can be effected by 12 miles of land transportation.

"In conclusion, I think with a great many that you have at Jackfish lake and neighbourhood a property of great value, and well deserving the attention of capitalists."

Following is an extract from the report of Peter McKellar of Fort William under date of March 15th, 1877:

"The location is half a mile square, covered with small pine, spruce, tamarack, poplar and birch, suitable for mining purposes in general; and large pine can be got from the north, patches of which the road to Baril Portage must pass through. The surface is undulating rocky, the lower surface being covered with deep mossy accumulations and the higher parts mostly with sandy soil, which when cleared would produce fair crops of hay, oats, potatoes, etc. Near the vein runs a small stream, admirably suited for supplying the stamp mill with water. Peter McKellar's report.

"The vein passes diagonally through near the middle of the property, traversing the Huronian series, which here consist of highly inclined greenish slaty strata, partly displaced in the vicinity by intrusive granite. Professor R. Bell, in his report of the mineral-bearing rocks of lake Superior, which appeared in the Globe, March, 1874, states: 'The gold of British Columbia and other regions occurs in rocks similar to those of the Huronian series.'

"I have examined the vein at various points for a distance of about 2,000 feet on this property, and about 1,200 feet on the adjoining Highland mining location; and I see by Captain J. Plummer's report that he traced it westward on the Shebandowan mining property for two miles further, which proves it to be a vein of great strength. As far as my examination went it appeared richer on the Jackfish lake property than on any other. The mining test of the vein was made on this location the winter following its discovery, five miners having been engaged for nearly a month. Two openings were made; one near the western boundary, the other about the centre of the property. At the latter place a depth of about 10 feet was sunk on the lode. Ore to the amount of about 100 tons was excavated. I was there while the work was in progress, and I can truly state that the more it was opened out the higher it rose in my estimation, and the opposite is the case almost invariably with poor mines.

"This vein like others is subject to contractions and expansions. The average width appears to be four to six feet, though in places much larger. It consists of two nearly equal parts: the one (generally in the middle) a soft

talcose slate, charged with iron pyrites, and carrying some gold ; the other quartz and some bitter spar, charged with galena, iron and copper pyrites, sulphide of silver and free gold, with occasionally small bunches of auriferous tellurium. The gold and silver are in general finely disseminated through the quartz and other ores, but here and there specimens are found that would yield $2,000 to $3,000 per ton. Captain Wm. B. Frue had the precious metals extracted from 126 lb. of selected ore, the average yield being about $500 to the ton, or gold $460, silver $40."

As our visit to this famous mine was a hurried one without a guide familiar with the workings, and the shafts were full of water, it was impossible for us to do much more than examine and bring away samples of the country rock and the ores. The ore on the dump is very striking and handsome, white quartz plentifully sprinkled with copper pyrites, iron pyrites, galena and some zincblende. Small quantities of telluride may be found also. An assay of some ore taken by myself gave ten dollars in gold and nine ounces of silver per ton.

Dr. Selwyn's opinion of the property.

Dr. Selwyn, when Director of the Geological Survey of Canada, stated that he considered the Jackfish Lake or Huronian mine the most promising mining venture he had seen in this region. "The lode is well defined and can be traced for a considerable distance to the southwest with an equally promising character, though yet undeveloped."[22]

As the Huronian mine was one of our pioneer gold mines, carried on for some time in the face of great obstacles, and as it and the Highland and other properties may be of importance in the future, it has been thought wise to quote somewhat extensively from various reports made upon it at the time it was opened up.

Recent discoveries near the Huronian.

Several locations have recently been taken up by Mr. James Hammond to the southwest of the Huronian mine. Specimens from some of these properties contain free gold and also sylvanite. Owing to lack of time we did not visit them, but returned to our camp on lake Shebandowan.

Copper ore on lake Shebandown.

Before setting off for the Mattawin iron deposits a visit was made to a point east of location ON3, on the shore of lake Shebandowan, southeast of the camp at the end of the portage. Talc schist, striking about east and west and with vertical dip, is here heavily charged with iron and copper pyrites for a width of twenty-five feet. At some points the copper pyrites forms almost solid masses. An assay of the pyrites gave only a very slight trace of gold, but the ore should be of value for its copper contents.

The Mattawin Iron Region.

An excursion to Greenwater lake and Mattawin river.

Leaving Mr. Burwash and the rest of the party to examine the geology of the country between lake Shebandowan and Savanne, Mr. Blue and myself with Mr. Hammond and three canoemen set out for the iron region of Greenwater lake and Mattawin river.

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[22] Geol. Sur. Can. 1882-3-4, p. 2.

Portaging south into the small lake, Loch Earn, we found Huronian rocks on its north side and red granite on the south. On the latter side some one has dug a trench, apparently to find the source of some boulders of quartz with copper pyrites ; but so far as seen, the bottom of the deposit of boulders, doubtless of glacial origin, was not reached ; and it is very doubtful if the mineralized quartz came from the immediately underlying granite. On Loch Earn.

Another portage leads south into the charming Greenwater lake, on whose southeast shore several iron locations have been taken up. A visit was made to location R526, near the lake, where green hornblendic schist was found with a strike nearly north and south and dip not far from vertical. Interbedded with the schist are bands of very fine grained magnetite, mixed with a little hornblende. The beds of ore are often finely contorted, and the width of the part rich in magnetite is forty-eight feet. The country rock to the east is hard, very fine grained green schist ; and to the west a porphyroid containing quite large hornblende crystals, followed by green hornblende schist. Mr. Hammond states that this ore body may be traced for miles with varying width, and that five locations have been taken up in all. The ore, so far as we observed, is free from sulphides. Iron locations on Greenwater lake.

This or an adjoining location was visited by Mr. W. McInnes, of the Canadian Geological Survey, in 1892, and a specimen which he collected afforded when assayed in the laboratory of the survey the following results :[23]

Metallic iron	52.82 per cent.
Insoluble matter	22 31 "
Titanic acid	none.

An assay by Mr. Hille of Port Arthur gave similar results ; iron 53 33 per cent., phosphorus 0.055 per cent.

The quantity of ore available near Greenwater lake must be very large, and it seems free from objectionable ingredients, but not very high in metallic iron. It is a softer ore than that of the Atik-okan.

At Long Point lake, east of Greenwater lake, dark green serpentine is found associated with magnetite.

A series of rivulets, marshy ponds and bad portages leads easterly to Copper lake, where rock is once more seen at a contact of Laurentian and later rocks, coarsely porphyritic syenitic gneiss on the north side of the lake and finely banded slaty rocks and schist with a strike of 130° and steep dip on the southeast side, at the portage. The slaty rock has scarcely the look of the usual Huronian. The outlet of the small lake is over a wall of slate forming a pretty cascade immediately after the stream leaves the lake, a proof of the very modern geography of the region, since the outlet has not yet been appreciably lowered. On Copper lake.

A long portage leads into Hawk lake, where granite is found.

GOLD CREEK.

Ascending Gold creek from Mattawin river, granite is exposed at one or two points not long before reaching the head of canoe navigation at what has Gold locations on Gold creek.

[23] Geol. Sur. Can. 1892-3, pp. 25A and 37R.

been named the Quartzite mine; but above this the rock is a gray, fine grained schist, often considerably charged with sulphides and now and then containing small veins or irregular masses of quartz. As a number of gold locations have been taken up on these rocks an afternoon was spent in examing them. The banks of the creek were followed for about a mile from north to south and excursions made to each side. At several points the rock has been stripped and pits have been blasted out in four places, while at one point the face of a cliff has been blasted away and a few feet of drifting done. Much of the rock is charged with iron pyrites, and any gold carried by the rock comes probably from this mineral. The rock, which is almost always distinctly schistose, varies much in strike and sometimes appears to have two distinct cleavage directions; in one instance 120° and 35°. Microscopic examination proves that this rock is not a quartzite, though generally very siliceous, but usually a hälleflinta or microgneiss. One portion looking much like quartzite, but having little or no cleavage, may be described as a felsite perhaps. Our examination covered parts of AL61 to AL65. This rock as a whole is said to run a few dollars in gold to the ton. Three specimens selected by myself from different points as average examples were assayed in the laboratory of the School of Science, Toronto, and yielded each a trace of gold, less than a dollar per ton; but it may be that specially selected samples would be much richer. It is probable that rock occurring in such limitless amounts and so easily mined would pay to work on a large scale, such as that of the Treadwell mine in Alaska, with an average gold contents of not more than $3.00 or $4.00 per ton; but our assays show much less than that amount.

The hälleflinta of this region, though probably Huronian, differs greatly from the typical rocks of that age. It shows some likeness to Dr. Lawson's Couchiching as found occasionally on Rainy lake, but is harder and finer grained.

MATTAWIN IRON RANGE.

Mattawin hematite deposits.

Turning eastward and northeastward from the Quartzite mine, we traversed on foot a level, comparatively dry country for eight miles before reaching the Mattawin hematite deposits, which rise as sharp, elongated hills. There are eight of these hills in the Mattawin Iron Co.'s locations, the eighth, on location W222, being the most westerly and the first, on location W211, the most easterly.

Mr. Blue and I visited hills No. 8, 7, 5 and 1, the first two being north of the Mattawin and the last two south of it.

Hill No. 8.

On hill No. 8, which rises steeply above the valley, the ore is fine grained and purplish gray to red with a few seams of red jasper, the richest ore apparently lying close to the jasper. The country rock on the south side of the hematite lens, which has a strike along the cleavage of about east and west, and a vertical dip, is soft, dark gray slate; and on the north side a very fine grained greenish gray schist, or glistening slate, which would be called a phyllite by European petrographers. It is prob-

able that these rocks are later than Huronian, and are equivalent to the Animikie.

One or two pits have been sunk on this hill, disclosing a large amount of fair ore. The width of hematite is four hundred feet and the length of the lens about a quarter of a mile.

Hill No. 7.

Hill No. 7 on W221 rises a hundred and eighty feet above the valley, as shown by aneroid, and contains a variety of ores, some grayish red and somewhat mixed with rock matter, other parts "blue" ore associated with a dark cherty material. The strata are very contorted in places, and the strike about 110° at a point where a diamond drill has been used for exploratory purposes. The greatest width of ore, with some stony bands, is four hundred and eighty-five feet, and the length about fifteen chains. Some specimens of the ore are said to assay fifty-five per cent. iron.

Hill No. 5.

Crossing the Mattawin river we visited Hill No. 5, on its southern bank, where a band of blue black, somewhat magnetic ore is found, having a strike of about east and west and a dip of 80° to the north. On the south side of the ore band a gray, spotted slate, like the *Knotenschiefer* of the Germans, is found. The width of more or less pure ore is fifty feet, and it is said to extend for a quarter of a mile.

Hill No. 1.

Hill No. 1, on location W211, displays a quite different ore from any of those hitherto mentioned. A shaft has been sunk near the summit to a depth of fifty-six feet, and the material taken from it is a handsome jasper breccia, resembling specimens from parts of the Vermilion range, Minnesota. Large fragments of banded red jasper, or less often of black chert, are cemented with very fine grained magnetite. The proportion of iron ore increases as the shaft goes down, but solid ore had not been reached when the work was abandoned.

Analyses.

The following analyses of Mattawin iron ores were made by Dr. Goodwin in the laboratory of the School of Mining, Kingston, and are published by the kind permission of Mr. J. Bawden, secretary of the company.

	I.	II.	III.	IV.
Iron	68.47	63.550	51.320	60.49
Sulphur	none	0.044	0.700	.....
Phosphorus	none	0.014	0 046	0.08
Titanium	.....	0.021	.....	....
Silica	.....	.....	19.59	.....

The last analysis is of ore from Hill No. 8, but the localities from which the other specimens were taken are not mentioned, nor is anything said as to whether they are picked or average samples.

General promise of the range.

Looked at as a whole, this region contains immense bodies of ore, hematite and magnetite, not very high in iron, but generally free from sulphur, and so placed that mining operations would for a long time consist simply in quarrying. The country is well suited for railway building, so that a short branch line connecting with the Canadian Pacific at Finmark, or with some point on the Port Arthur, Duluth and Western Railway, could be built inexpensively, affording an outlet to lake Superior.

From the Mattawin river to Finmark on the C.P.R.

The Mattawin river runs much of the way through alluvial clay and well stratified sand. Its bottom in many places is covered with boulders making canoe navigation very troublesome at the shallow water season.

Turning aside from the river toward Finmark station, Huronian rock is met once more a short distance south of the railway, a number of stringers of quartz with pyrite occuring in gray-green somewhat chloritic schist.

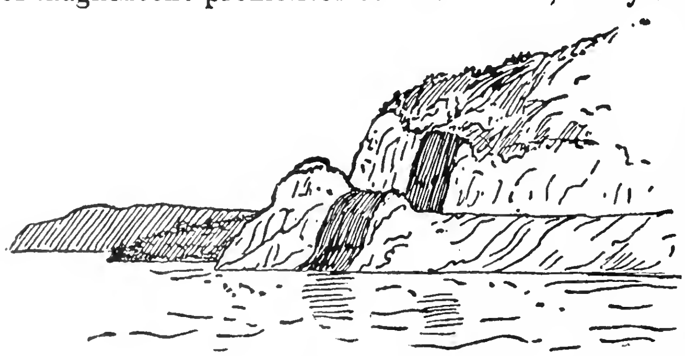
A striking feature in the surface geology of the Mattawin region is the absence of lakes. From hill No. 7, for instance, a view extending miles in all directions discloses no lakes, and but few streams or swamps, a feature that interferes with communication by canoe, but greatly favors railway construction.

JACKFISH BAY AND SILVER ISLET.

Empress mine.

On August 23rd, having seen Mr. Blue off on his canoe trip to Fort Frances, we took a train for Fort William. After visiting Port Arthur in order to obtain some information from Mr. Hille and other gentlemen, we embarked on the tug Salty Jack, August 24, to visit the Jackfish Bay mine, the tug having been chartered by the Messrs. McKellar to take a party of men with provisions, etc., to open up this property. I wish to express my gratitude for the kindness and hospitality of the Messrs. McKellar toward us during this visit to their location.

Jackfish bay is a well sheltered harbor one hundred and twenty miles northeast by east of Fort William, and the straightest course, passing a series of magnificent promontories and islands, many of them capped with flat sheets of diabase, leads through the open lake exposed to a heavy sea from southerly points. The Jackfish bay station on the Canadian Pacific is near the mouth of the harbor, not far from an island which cuts off the swells from the open lake. Here the railway turns toward the north and makes a detour of some miles with heavy rock cuttings and a tunnel before returning to the lake shore and continuing its course westwards. The scenery is very bold and striking. At the station red syenite shows itself, sometimes enclosing fragments of dark schist, which rock is found a little beyond the station on the hills. At the tunnel on the west side of the bay gray or pale flesh colored granite has been pierced and rises as a cliff above the water. At three points it is penetrated by black dikes of diabase, well seen from the water. One of the dikes is sixty feet wide. The microscopic characters of these rocks will be discussed in the petrographical portion of the report.



Dike in granite. Jackfish bay.

Three-fourths of a mile west of the tunnel a small quartz vein is found in the granite. Some years ago, as Mr. McKellar reports, rich gold specimens were obtained from it; but there was not enough quartz to justify mining it.

THE EMPRESS GOLD MINE.

The Jackfish or Empress mine was discovered two months before we visited it, by an Indian who brought in specimens of quartz to the Messrs. McKellar. It lies about two and a half or three miles inland from the head of the bay, and the trail ascends five hundred and eighty feet in that distance, as measured by aneroid. On the way four small but pretty lakes are passed at different levels. The area of granite extends about two and a quarter miles inland, when gray and green schists, no doubt Huronian, make their appearance. The vein was only partially stripped at the time we visited it, but appeared at its highest point to be forty feet wide, some strips of talcose or sericitic schist much impregnated with sulphides being included with the quartz, so that there would not be more than half that width of solid quartz. The vein had been traced, we were told, for nearly a thousand feet. It is apparently of a bedded or segregated character, with a strike of 70° and a steep dip, and has hard green hornblende schist on the northwest side, and softer hornblende-chlorite schist on the southeast.

Vein of the Empress mine.

The quartz contains much pyrite, some chalcopyrite and galena, but we saw no free gold, though it is said to pan well. Since our visit much more development has been done and some specimens rich in free gold has been shown me as coming from the mine.

An assay of a specimen of ore taken by myself gave $10.60 in gold and silver. If the ore will average that, the mine should be very valuable, for the quantity of quartz must be very great. It is to be hoped that the McKellars and their enterprising fellow citizens in Fort William and Port Arthur who have provided the capital for opening up and working the property will be well rewarded for their venture.

It is perhaps worthy of mention, as showing how the vast body of cold water in lake Superior affects its northern shores, that raspberries and blueberries were just ripening, and that strawberries were still on the vines on August 26th. Blueberries were begining to ripen on the north shore of Lonely lake, a degree and a half further north, on the 15th of July.

Late ripening of wild fruit on the north shore.

SILVER ISLET.

Returning by the Salty Jack, we had a calmer passsage and stopped some hours at Silver Islet, a few miles east of Thunder bay. Mr. J. W. Cross, who is now in charge of this once famous mine, was good enough to serve as guide to the stamp mill, in the village of Ryanton on the mainland, and to the works on the island itself.

Silver islet mine and works.

The district as a whole consists of fine-grained, gray Animikie slate, here and there pierced or capped with outflows of diabase, the flat-topped hills to the north being covered with sheets of this rock. The islet itself, once only seventy by forty feet in dimensions, has been enlarged with cribwork filled with rock from the shaft until there is room for several buildings. The materials dumped from the shaft, thirteen hundred and fifty feet in depth, to fill the cribs have in some places been washed by the waves so as to form a

beach on which fragments of gangue are being rolled to well rounded pebbles. Some of these pebbles are rich with native silver.

The dump has been many times picked over, but still affords interesting specimens. We found, besides native silver, argentite, chalcopyrite; marcasite, blend and galena, with calcite and quartz as gangue minerals. Part of the ore on the dump consists of a breccia of diabase cemented with carbonates containing sulphides.

The Silver Islet ore was specially rich where the vein cut a dyke of eruptive rock, which is exposed at a point or two on the islet. Under the microscope this proves to be a diabase or quartz diabase, differing in character from the diabase on the mainland, and of coarser grain.

Edward's island.

From Mr. Cross I obtained a specimen of native arsenic from Edward's island, nine miles east of Silver Islet, where it occurs with a silver ore ; and it is evident that the region is rich in interesting minerals. It seems hardly probable that the Silver Islet vein, from which $3,250,000 of silver was produced between 1870 and 1884, is the only rich vein in the region, though, up to the present, no others have proved to be more than pockets.

Returning to Fort William we took a steamer for Windsor, where the salt works were examined, and reached Toronto on August 31.

General Conclusions.

Extent of the gold-bearing region.

As a result of the past summer's work in western Ontario, it may be stated in general that gold has been found either in visible particles or by assay in a stretch of country reaching from near the Manitoba boundary on Shoal lake eastwards to the Quartzite mine near Finmark station, a distance of two hundred and sixty miles ; and over a breadth of one hundred and twenty or thirty miles, from Minnietakie lake to the south shore of Rainy lake. It is not to be supposed of course that gold in paying quantities will be found everywhere within this area of one hundred and twenty by two hundred and sixty miles ; for probably two-thirds of this territory of more than thirty thousand square miles is Laurentian, which has never proved to be auriferous except near the margin of the Huronian. It is not even to be taken for granted that every stretch of Huronian rock in this area is auriferous, though in most cases where exploration has been thorough, gold has been found in traces, if not more abundantly, in veins from the Huronian of almost all parts of the field.

Interesting features of the field.

Two points have struck me forcibly during the summer, one the frequency with which true fissure veins bearing free gold have been found in or near masses of eruptive granite which have burst through the Huronian schists ; the other that at two points immense bodies of schist impregnated with sulphides, i.e., fahlbands, have proved auriferous, and in one instance a hill of porphyry of great extent shows the same feature.

Altered granites or protogine areas, with gold-bearing veins.

Looking first at the occurrence of gold in granitic rock, we find that in general the granite forming the country rock for gold-bearing fissure veins is apt to contain a considerable amount of plagioclase and to be modified by

shearing and weathering into a greenish rock, often called protogine, in which the mica or hornblende of the original granite is changed into sericite or chlorite. Generally the change has gone still farther at the immediate edge of the vein, the felspar being changed to sericite and other products, the rock taking on the look of a schist, probably as a result of faulting when the fissure was formed and of the action of circulating water during the filling of the vein.

Examples of the sort are found at Bunn and Scovil's vein on Bag bay, Shoal lake; at the Regina mine on the Lake of the Woods; at Foley's and other properties on the river Seine, and at Harold lake and Sawbill lake toward the eastern end of the gold field. Several other less important examples of the same character have been found, such as the Little Canada and Partridge lake locations.

As these deposits in granite are usually true fissure veins with well marked walls, and as the granite itself is in all probability simply the projecting surface of a profoundly thick mass, there is no reason to suppose that such veins will not prove to extend to great depths; though up to the present the deepest shaft sunk upon such a vein, that on the Foley property near Shoal lake, has gone down only to the depth of two hundred feet. At that depth there is, according to reports received, no sign of pinching out. Veins of this sort are now being worked with every prospect of success, and gold is being won from their ores at the Regina mine and at Harold lake; and there is reason to think that at least two other veins of the same kind will be worked during the coming year.

Gold-bearing schists, porphyries, etc.

Turning next to the wide diffusion of gold in schists and eruptive rocks, three examples were studied during the summer, the first on Minnietakie lake, twenty or thirty miles northeast of Wabigoon Tank on the Canadian Pacific Railway, where toward the southwest end the shore for long distances consists of schist charged with iron and copper pyrites. Every assay made of rock from this shore showed traces of gold; while similar rock from the north end of the lake or from Abram's lake, still further north, gave nothing. The highest of our assays from this region gave only $2 per ton however. A similar deposit is found at the Quartzite mine near Finmark, where a fine grained gneiss or hälleflinta containing pyrites shows traces of gold in every assay.

The hills of quartz porphyry, generally much sheared and metamorphosed, on the northwest shore of Round lake, also contain iron and copper pyrites, and in every case yield a small quantity of gold when assayed.

If these practically limitless bodies of rock should be proved to contain on the average even $3 or $4 per ton of gold they will turn out to be very valuable properties; but our assays, from samples taken it is true as specimens of rock and not picked as being most likely to be auriferous, have not yielded more than $2 per ton.

If veins exist in these hills of slightly auriferous rock, one would expect to find the gold concentrated in them as the silver ores of Norway are in veins passing through similar fahlbands.

The encouraging aspects of the region.

Looking at the region as a whole one may note two encouraging features: first, the area in which gold is known to occur is steadily increasing as prospectors go farther afield in our Huronian tracts; and secondly, a few of our mines are now under the control of skilful and practical owners and managers who intend to work them so as to make a profit from the gold produced, and not simply to sell them as prospects to some capitalist who knows nothing of the conditions of the region. A few successful business ventures will prove the turning point in the long history of failure in our gold mining; and will give an impetus to the development of our mineral resources that has long been looked for, but looked for in vain.

GLACIAL AND POST GLACIAL DEPOSITS.

Evidences of glacial action in the region.

The whole region shows in a marked degree the effects of glacial action in polished and striated surfaces of rock, in boulder clay and morainic deposits, and in the rock-rimmed or drift-dammed character of most of the innumerable lakes scattered over the country. Beside the effects of ice action, there are many examples of stratified sand and clay deposited in the great lakes which followed up the retreat of the ice front at the close of glacial times.

It is intended to put on record here the results of our observations, and to give a general idea of the accepted theory of the origin of the superficial deposits, which in some places have great importance as affording the only wide stretches of cultivable land in the region.

Directions of glacial striæ.

Observations on the direction of glacial striæ were made especially at points not reported on by Dr. G. M. Dawson and Dr. A. C. Lawson, who have noted them from many points on the Lake of the Woods and Rainy lake[24]. The bearings given are reduced to the astronomical north, the variation of the compass for the different portions of the region having been supplied by Mr. Stupart, Director of the Meteorological Service of the Dominion.

LIST OF GLACIAL STRIÆ.

	degrees.
Shoal lake, west of Lake of the Woods......	46
Frenchman's head, south of Lonely lake....	44
Pelican lake	29
Between Minnietakie and Abram's lakes....	34
Minnietakie rapids........................	49
North shore of Minnietakie lake	39
South shore of Minnietakie lake............	44
Southwest shore of Minnietakie	64
A little west of last point..................	59
Still further west..........................	59
Long southwestern bay of Minnietakie lake.	39
Shoal lake, Seine river....	54

[24] A. C. Lawson in Geol. Sur. Can., An. Rep. 1885, p. 132, CC. etc. and 1887 p. 164 F, etc. Also Warren Upham in Geol. and Nat. Hist. Sur. Minnesota, 1893, p. 35, etc.; and G. M. Dawson, Geol. and Resources of the 49th Parallel. pp. 205 206.

Locality	degrees.		
Fifth portage up Seine river	48		
Seine river above Calm lake	18		
Seine river east of Calm lake	8		
Island quarter of a mile east of last	3		
Deep bay farther east on Seine river	28	(earlier.)	8 (later.)
Large island in archipelago	8		
Another island	8		
North bay of lake expansion	8		
Small island a little east of last	43	(earlier.)	(18 later.)
Mouth of Eye river	8		
Steep Rock lake, west side of third reach	43		
Steep Rock lake, lower end	48	(earlier.)	(8 later.)
Atik-okan river	43		
Islet north of Sand Point, Lac des Mille Lacs	37		
Mouth of Savanne river	42		
South end of Lac des Mille Lacs	27		
Hight of land south of Lac des Mille Lacs	37		
Lake Shebandowan	47		
Mattawin river	27		
Gold creek near Mattawin river	7		
Gold creek at another point	0		
Finmark	42		
Jackfish Bay, lake Superior	22 to 27		

General tendency of the striations.

The directions given in the previous table are expressed in degrees east of north. It will be observed that there is a general tendency of the striations in two prevalent directions, northeast and southwest, and nearly north and south, the latter trend occurring along the Seine river between Calm lake and Steep Rock lake and also on the Mattawin river and its tributary, Gold creek. More than two-thirds of the readings range in the neighborhood of northeast and southwest, the extremes being 22°—64° east of north and west of south, and the mean almost exactly 45°. In three instances intersecting striations were found, in each case the later of the striations running more nearly north and south than the earlier ones. In several examples along Seine river it is possible that earlier, northeast and southwest, striations have been wiped out by later glaciation from a more northerly direction. The infrequency of the later striations having a north and south direction suggests that they were not produced by a second, widely extended ice sheet, but perhaps by lobes of ice advancing locally during the general retreat of the glacial mass. The lobe which produced the later striæ between Calm lake and Steep Rock lake must have had a width of at least twenty-two miles. There is no observable reason in the configuration of the hills and valleys of this special region to account for so marked a change of direction in the readvance of the ice, and it is worthy of note that Lawson found only the older set of striations (approximately northeast and southwest) in the Rainy lake region, just to the west[25], though four or five instances of the nearly north to south direction are mentioned in his account of the Lake of the Woods region, still farther to the west[26].

It is held by Mr. Warren Upham that toward the close of the Ice Age there was a deflection of the glacial current, bringing limestones from the

[25] Geol. Sur. Can. 1887, p. 161 F, etc. [26] Ibid. 1885, p. 132 cc, etc.

Winnipeg region southeast to the Lake of the Woods and Rainy river[27], and that this change of direction of the flow of ice is still more marked in Minnesota and as far east as the Wisconsin boundary.

It may be that the centre of glaciation proved by Tyrrell to have existed just west of Hudson bay may have been active somewhat later than the one east of Hudson bay, and its ice sheet may have covered the region of northerly striations after the eastern ice sheet had retreated.

Two centers of glaciation.

In general we may divide the area covered by a great glacial sheet into two parts, a more or less broad peripheral one where ground moraine, or boulder clay, has been left in thick beds, with here and there a loop of terminal moraine rising ridgelike upon its surface ; and a wide central area which has been scoured more or less bare, the loose materials resulting from ages of weathering having been swept away and the solid rock beneath having been carved into the rounded form known as *roches moutonnées.* The central portions, where the pressure of ice was greatest, have been areas of erosion, and the edges where the ice was thinned and rendered stagnant have been areas of deposit. The northern and western portions of Ontario, the "rocky lake country," illustrate the erosive power of an ice mass ; while southern Ontario and the States to the south give an example of an area of deposit.

Areas of erosion and areas of deposit.

On this account the region now under discussion, lying somewhat within the area of erosion, has commonly been swept very bare, its rounded hills and valleys showing boulder clay as a rule only in the lee of projecting hills. Boulder clay or till of the kind usual in southern Ontario seems not very common, though good examples of stony blue clay were observed on Lake Minnietakie. More commonly one finds irregular fragments of rock, often quite angular, pushed into the lee of some knob or ridge of rock, little or no clay filling the interstices.

Terminal moraines and

Terminal moraines are not often a noticeable feature, though stony ridges, probably of that nature, are found on the nine-mile portage north of Wabigoon Tank on the Canadian Pacific Railway.

Huge perched blocks are found in a few places, south of Elbow lake for instance, stranded indiscriminately on the summit of rocky hills or in the valleys. Very often such blocks, and also the smaller masses found in the lee of hills, are found to have been transported only a short distance, having no rounding of edges or corners and being of the same lithological character as the neighboring hills.

stranded boulders.

LACUSTRINE DEPOSITS.

Postglacial deposits.

Postglacial deposits of stratified gravel, sand and clay have been formed at a number of points in the region, and represent the work of lakes and rivers during or since the departure of the ice. The best example of these deposits is to be found along Rainy river, where stratified calcareous clays provide several townships of excellent soil, the farms along the Ontario side of the river giving the traveller who has just come by steamer from the rocky hills of Rat Portage and the Lake of the Woods a very pleasant surprise.

[27] Nat. Hist. Sur. Min. 22nd An. Rep., p. 42.

These lacustrine beds have roused the interest of every geologist who has visited the region, and accounts of them may be found in various reports, the matter being well discussed by Lawson in his report on the Rainy lake region.[28]

Lacustrine beds of the Rainy river region, and the probable source of their material.

A little below the falls at Fort Frances the escarpment cut by the turbulent current rises about twenty-seven feet, the lower half consisting of a bed of grayish clay with small striated boulders, probably a somewhat re-arranged boulder clay, and the upper half of stratified clay and coarse sand containing many small shells (sphaerium) and a few large unios. The most interesting feature of the boulder clay is the number of yellowish-white limestone pebbles and boulders, very like certain limestones near Winnipeg, both in general appearance and the species of fossils which they contain. These boulders, which have been burnt for lime along Rainy river, form a startling contrast to the granites, gneisses and green schists found elsewhere in the region ; and various suppositions have been made to account for their occurence so far from home, glacial ice or icebergs being generally held to have transported them. Dr. Dawson suggests that they may have heen derived from a floor of limestone in the southern part of the Lake of the Woods, but Mr. Upham considers that they have been transported by glacial action from the paleozoic region west of the Lake of the Woods and lake Winnipeg. The fact that, though now found in stratified beds, the limestone pebbles are often polished and striated, favors the theory of glacial transport.

Lake Agassiz.

Such pebbles and boulders have not been found east or north of the Rainy river and Lake of the Woods region, and it is held by Upham and Lawson that this represents the eastern boundary of glacial lake Agassiz The western and southern shores of this great extinct lake have been traced in Manitoba by Mr. Upham and Mr. Tyrrell very completely by means of beaches distinctly cut at different levels, but such beaches have not been found to the north and east. Mr. Upham estimates that lake Agassiz covered no less than 110,000 square miles, much exceeding the combined areas of the five great lakes of the present day, which amount to only 94,650 square miles ; and holds that the northern and eastern shores of this vast body of water were formed by the ice of the retreating glacier. Mr. Tyrrell thinks however that lake Agassiz never covered the whole of this area at once, but formed a belt of water lying along the edge of the glacier and following it up in its retreat.[30] Lakes Winnipeg, Manitoba and the Lake of the Woods may be looked on as remnants of this great body of water left behind when the Ice Age ended and the present drainage system came into operation. The richest land of Manitoba is formed of the silts of lake Agassiz, and the farm land of Rainy river has been deposited in one of its southeastern bays, where the calcareous till has been worked over into stratified clay.

Other areas of lacustrine deposits, on Seine and Turtle rivers, Wabigoon lake, and

While the Rainy river area of good soil is much the largest of the lacustrine deposits in western Ontario, it is by no means the only one. Smaller, but still important areas occur on Seine river, Turtle river and particularly

[28] Geo. Sur. Can., 1887, p. 169F, etc. [29] Geol. Sur. Can., 1888-9, Report E.
[30] Am. Geol., July, 1891, p. 26.

in the neighborhood of Wabigoon lake. In each of these localities one finds widespread stratified clay forming good soil, but, so far as observed, free from the yellow limestone boulders. Lawson mentions the deposits just referred to ; but thinks that the one near lake Wabigoon was formed at a later stage in the recession of the ice barrier, after the waters of lake Agassiz had shrunken beyond the height of land and formed a relatively small body of water between the height of land and the ice to the north.[31] Still other areas of stratified clay and sand exist to the north and east, and one of them, at the Hudson Bay post on Lonely lake, is of considerable interest.[32] During our visit to Lonely lake last summer this deposit was somewhat carefully examined, and was found to present some peculiar features. A little west of the post, which stands on a strip of sand and gravel rising only a few feet above the lake, but backed by hills of sand, there is an escarpment thirty-five or forty feet high, though the lower part of the section is hidden by a talus. About half way up one finds stratified sand, then what appears to be sandy till containing a few large boulders and some small polished stones, and above all a few feet of stratified clay, the different beds varying greatly in thickness. Stratified clay is found near the lake level, where the bank is low, a few rods to the east of the highest cliff, perhaps part of a lower bed of stratified clay.

Lonely lake.

Features of the Lonely ake deposit

As the materials from the escarpment are worked up by the waves, the sands are drifted along shore and partly added to the sand beach on which the store and other buildings of the post stand. The gravel is shifted a shorter distance in the same direction, and the large stones form a sort of rough breakwater just below the cliff. Most of the larger stones are Laurentian gneisses, but some Huronian stones occur also. The pebbles are chiefly of the same nature, but include some flat concretions from the sandy cliff, a few exemples of chert and jasper, and a few yellow limestones very like those of Winnipeg. Many of the fragments of jasper are small, sub-angular and have the oolitic look so common in the red jasper associated with the Minnesota iron ores, and found also in the Nipigon region by Dr. Bell. Thin sections of some of these jaspers examined under the microscope show exactly the structure figured and described by Mr. J. E. Spurr from the Mesabi range, Minnesota, and supposed to represent altered glauconitic material.[33] Many of the cherty fragments, which are generally weathered to a creamy or reddish color, are fossiliferous, containing especially portions of corals, such as favosites of Niagara type. Mr. B. E. Walker, to whom the fossils were submitted for determination, names one very perfectly preserved pygidium of a trilobite *Encrinurus nereus* (Hall), and states that the type specimen is from the Niagara at Racine, Wisconsin. The yellow limestone fragments, which sometimes contain cherty parts like those found separate, are also fossiliferous, crinoid stems, fragments of brachiopods and of cyathophylloid corals being found in them. Looked at as a whole, Mr. Walker thinks the fossils are probably of Niagara age, but possibly Lower Devonian.

[31]Geol. Sur. Can., 1887, p. 176F.
[32]Summary Rep. Geol. Sur. Can., 1893, pp. 17-19, Mr. Dowling.
[33]Bul. X, Minn. Geol. Sur., 1894, p. 230, etc.

Just north of the Hudson Bay post there are sandy ridges and several small lakes, one a steeply walled kettle some sixty feet deep, the region as a whole being probably morainic, though our observations were not extensive enough to settle its character more particularly.

There are stratified sands to the south of Lonely lake and on lake Minnietakie, where a sand cliff rises fifteen or twenty feet above the water on the southern shore. Lonely lake is not far below the water shed, but it is unlikely that the hills north of it rise high enough to receive any of the beaches of lake Agassiz; and it is probable that the deposits just described were formed at the edge of the ice at the time of Upham's West Superior lake,[34] the eastern successor of lake Agassiz, perhaps on an outlet toward the north past a lobe of ice. In that case the jaspers and fossiliferous cherts and limestones may have been transported from the south and west by floating ice.

Possible origin of the Lonely lake beaches.

On the other hand, both jaspers and fossiliferous paleozoic pebbles and boulders may have had their origin far to the northeast, on the shores of Hudson bay, and may have been transported glacially to the Lonely lake region, the waters of lake Agassiz or its immediate successor having merely rearranged the materials already on hand. Dr. Bell has described red jasper with "floating particles," like that of the Nipigon series near Thunder bay, lake Superior, from Long island on the east shore of Hudson bay, nearly seven hundred miles northeast of Lonely lake;[35] and has found yellowish limestone, probably of Niagara age, on Albany river near the southwest side of James bay,[36] and at other points near Hudson bay. Mr. A. P. Low finds similar rocks on Severn and Fawn rivers near the west shore of Hudson bay.[37]

Whatever the source of the materials deposited, there seems good evidence in the Lonely lake escarpment of the action of a large lake having its surface at least thirty-five or forty feet above the present water level, and apparently bounded toward the north by a great glacier.

It is entirely probable that other areas of silty lake deposits will be found here and there overlying the Laurentian and Huronian rocks, and furnishing sections of good soil.

Further northeast, down the slope of the drainage toward Hudson bay, Dr. Bell has shown the existence of deposits containing marine shells, proving that the basin of Hudson bay at the close of the glacial period stood about four hundred and fifty feet lower than now;[38] but it is unlikely that this depression was ever great enough to make lake Agassiz or the West Superior lake an arm of the sea.

Depression of the Hudson bay basin at the close of the glacial period.

[34] Upham, Geol. and Nat. Hist. Sur., Minn., 1894, p. 157, etc.

[35] Geol. Sur. Can., 1877-78, p. 23C.

[36] Ibid., 1871-2, p. 111.

[37] Ibid., 1886, p. 18F.

[38] Geol. Sur. Can., 1872, p. 112; 1875-76, p. 340.

STRATIGRAPHICAL AND PETROGRAPHICAL NOTES.

Distinctions and relationships of Laurentian and Huronian rocks.

During the summer a wide range of the so-called Laurentian and Huronian rocks of Ontario west of lake Superior have been visited, and the impressions of the previous year confirmed. Following Lawson's excellent work on the Lake of the Woods and Rainy lake,[39] the distinction between these two formations has been made a purely petrographical one, the underlying gneisses and associated granites and syenites being called Laurentian, notwithstanding the fact that at many points they display a well marked eruptive contact with the overlying rocks; and hence must have consolidated at a later time than the Huronian. In the region visited there are a few rocks of gneissoid character which show a markedly banded structure, suggesting that they may have been sediments older than Lawson's Keewatin and Couchiching, but the great majority of the gneisses penetrate the overlying schists and contain fragments of them, angular or more or less blending into the surrounding gneiss.

It would no doubt be more logical to confine the name Laurentian to the oldest complex of thoroughly crystalline rocks, serving as a foundation for all succeeding rocks, and to describe the clearly eruptive rocks which penetrate and more or less modify the overlying schists as eruptives of later date than at least the earlier members of the Huronian. If this were done, very little of the territory under consideration could be classed as Laurentian, perhaps none of it with certainty. Until much more minute and careful work has been done in western Ontario, it will be impossible in practice to separate the gneisses, granites, etc., of the two ages with any certainty; and for practical purposes the petrographical distinctions are sufficient. On this account no attempt has been made to make the present work accord with the conclusions so patiently and exhaustively worked out by Van Hise in his correlation paper on the Archaean and Algonkian.

Nor does it seem advisable to change the well known Canadian name of Huronian, although some of the rocks overlying the so-called Laurentian are perhaps older than the typical Huronian, e.g., the Couchiching mica schists and gneisses of Lawson.

In the region referred to in this report, besides the almost certainly sedimentary Couchiching rocks at the base, we find the very complex series of eruptives, pyroclastics and, less commonly, waterworn clastics of Lawson's Keewatin, to be of widespread occurrence and great importance as containing the gold-bearing veins of the district. Lawson distinguishes a lower, generally basic, series of Keewatin rocks, largely green in color; and a higher, more acid series, quartz porphyries, felsites, schists, etc. The green Keewatin rocks and the eruptives which burst through them are more commonly auriferous than the more acid upper series.

[39] Geol. Sur. Can., 1885, Part CC, and 1887, Part F.

MINNIETAKIE AND SHEBANDOWAN REGIONS.

In last year's report instances were given where quartz porphyry cutting the green schists as a dyke had been rendered schistose, the strike of the schist in the dyke being the same as that on each side,[40] showing that in at least some cases the schistose structure is no indication of the original bedding of the rock ; and similar proofs were found this summer on the shores of lake Minnietakie, felsitic-looking schists crossing the strike of green schists.

Examples of peculiar structure.

The relationships of the so-called Laurentian and Huronian have been very fully discussed by Lawson in his two reports on the Lake of the Woods and Rainy lake ; but it may be mentioned that similar relations have been observed north of lake Minnietakie and near lake Shebandowan.

In the former portion of the region on the shore of Canoe lake, on the way south from Lonely lake, one finds gneiss typically Laurentian in look, having flesh-colored layers from a half-inch to three inches in thickness, separated by gray layers of similar thickness. This banded gneiss includes large and small fragments of a dark schistose rock, sometimes angular, sometimes tailed out. This gneiss has not at all the look of the granitoid gneisses of Rainy lake, and the breccia-like appearance may have resulted from the unequal plasticity of the two rocks when acted on by shearing forces at a temperature below that of fusion.

Not far from the previous example a glaciated surface on the shore of Canoe lake displays a most complicated structure. A gray, medium grained gneiss and a darker schistose rock have been crushed into fragments, large and small, slightly disarranged, and then cemented with a small quantity of granitic paste. The large fragments have sometimes been again broken and slightly faulted. The darker, dioritic portions have sharper edges than the gneiss when faulted in this way. Through the whole pass thin dykes of pegmatite of a different character from the cementing granite. May not this gneiss and diorite schist be original Laurentian rock not greatly softened by heat?

Half a mile below Pelican rapids a large mass of dark mica schist, looking something like a Couchiching rock and filled with garnets, is seen imbedded in fine grained gray gneiss ; a little above this rapid darker and paler gneisses are found interbedded with one another, and on Pelican lake the gneiss and green hornblende schist alternate at one or two points before one comes upon the Huronian area proper.

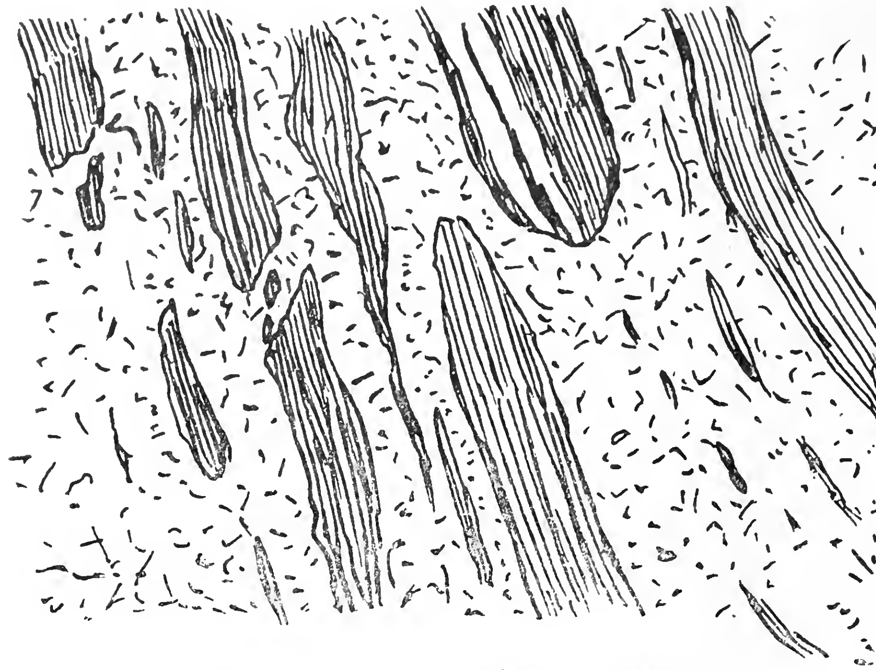
At the southern end of Kashabowie lake, between Lac des Mille Lacs and lake Shebandowan, a contact of coarse grained gray or red porphyritic granitoid gneiss with Huronian schist was observed by Mr. E. Burwash last summer. The granitoid gneiss at some points might be described as forming a gigantic breccia with the pale gray schist, large bands and fragments being slightly separated by the gneissic paste. This example is not unlike some of the contacts seen on Rainy lake and well described by Lawson.

Admitting that, so far as studied, practically all of the so-called Laurentian of this region underlies the lowest Huronian rocks with an eruptive

Character of the real Laurentian.

[40] Fourth Rep. Bureau of Mines, 1894, p. 87.

unconformity, it becomes a question of great interest to settle the character of the real Laurentian, which must have formed the solid basis on which the



Inclusions of schist in granitoid gneiss. Kashabowie lake.

Huronian rocks were deposited. Dr. Lawson has discussed this problem in the light of the pebbles and boulders contained in the Keewatin schist conglomerates [41] He describes pebbles of quartz, granite and felsite or quartz porphyry. Some attention was paid to this problem by us last summer, and the results may be given here.

A schist conglomerate a little below Abram's lake, some miles south of the contact of Laurentian and Huronian, contains many well rounded boulders, some a foot in diameter. Thin sections of three of them prove that they are granites, consisting of quartz, more or less crushed or with undulatory extinction, orthoclase containing many flakes of secondary muscovite, an unusual amount of plagioclase and a small quantity of some dark silicate completely changed to chlorite and calcite. These rocks are not greatly different from eruptive granites found piercing the Huronian schist a few miles to the south.

ERUPTIVES AND CONGLOMERATES OF SHOAL LAKE REGION.

Granite and schist conglomerates of the Shoal and Bad Vermilion Lakes region.

On account of the important gold bearing veins found in the area of eruptive granite between Shoal lake on Seine river and Bad Vermilion lake some time was devoted to the study of that region and a somewhat careful collection was made of the materials occurring in the schist conglomerate adjoining the granite boss, one of the conglomerates examined by Lawson.[4 As he states, the pebbles, which vary in size, and are usually only a few inches in diameter, are distinctly water-worn, rounded or oval in contour, and are enveloped in a green chloritic schist. The schistose structure of th

[41] Geol. Sur. Can., 1887, 82 F, etc

matrix probably results from pressure and shearing. Occasionally a pebble shows the effect of shearing action, being broken and the parts somewhat faulted.

Beside the pebbles of felsite and quartz porphyry mentioned by Lawson, a number of other species of rocks are found, such as a white, fine-grained, pulverulent sandstone almost free from cement; a few pebbles of medium to coarse-grained gneiss and granite; dark green graywacke and chloritic and sericitic schists of exactly the same character as the adjoining Keewatin rocks.

Broken pebble, schist conglomerate. Shoal lake

At Wiegand's point on Shoal lake the conglomerate consists of large stones, occasionally two feet in greatest diameter. Some of the softer schistose boulders have yielded to shearing. H. V. Winchell and U. S. Grant find, among pebbles like those referred to, also black and red jasper.[43]

Constituents of pebbles of the conglomerate.

Thin sections of nine of these boulders or pebbles have been examined microscopically. Among them are only two which may be metamorphosed sediments; two are granites, green gray and containing a considerable amount of plagioclase; and the rest quartz porphyries, one of them sheared into a sericitic schist. One of the porphyries has a poicilitic groundmass, and another is of special interest since it displays a very perfect spherulitic structure, the spherulites ranging in size from a diameter of a quarter of a millimeter to two millimeters. They are pale gray and are imbedded in a darker gray groundmass, the latter making up less than half the rock

The groundmass is micrographic, and consists, apparently, of minute individuals of felspar, quartz and chlorite. The porphyritic minerals are quartz, often dihexahedral, orthoclase and plagioclase. The quartz crystals, which are somewhat rounded and embayed, form the commonest nuclei for the spherules, but occasionally a felspar served as starting point. In several cases long slender strips polarizing uniformly with the nuclear quartz extend into the feathery intergrowth of quartz and felspar forming the spherule, but more commonly no connection of the sort can be seen. The radiating feathery intergrowths often show curved, plumlike forms, which generally have not quite parallel extinction.

None of the other sections made from these pebbles require special mention.

Near the corner post of AL112-114-115 at the highest point in the region, a short distance northeast of the granite area, one finds a conglomerate or breccia of a different character in some respects. The sub-angular pebbles, one of which measured six inches by four, consist of quartz porphyry, felsite and some other compact greenish rock and quartz. The cement is not

[42]Geol. Sur. Can., 1887, p. 82 F. [43]Geol. Nat. His. Sur., Minn., 1894, p. 65.

schistose or markedly chloritic, but has the appearance of a graywacke containing many angular quartz fragments. While the pebbles are of much the same character as those of the schist conglomerates on Shoal lake, the rock has evidently suffered much less from shearing and other metamorphic influences.

Source of the pebbles of conglomerate.

Looking at the conglomerates as a whole, two or three interesting inferences may be drawn from the rocks which they contain. First, several of them, such as the pulverulent white sandstone and the spherulitic quartz porphyry, appear to have no analogues in the region; secondly, that few or none of the pebbles, so far as my observations go, can be looked on as probably derived from the underlying Couchiching rocks, though Lawson looks on the rocks under discussion as a basal conglomerate of the Keewatin, separating it from the Couchiching;[44] lastly, that the rocks represented in these boulders and pebbles, with the exception of the sandstone and one or two of the porphyries, can be quite closely paralleled in the schistose and eruptive rocks of the surrounding Keewatin, and the later eruptives which burst through them. As Lawson has shown, these schist conglomerates appear to lie near the base of the Keewatin, which makes the origin of their Keewatin-like materials all the more puzzling.

The source of these remnants of a portion of the earth's crust once solid and worn by the action of the sea, but now vanished, is certainly mysterious. Perhap's Lawson's suggestion that they are parts of the floor on which the Keewatin rocks were deposited, since fused to form the "foliated granite known as the Laurentian gneiss,"[45] is the correct one; but it seems singular that the original material of these boulders. which in the main resemble the present Keewatin, should have been fused to form granite, while the Keewatin immediately overlying was not at all fused, but only rendered somewhat more crystalline.

The breccia-like conglomerate found at the highest point in the region, while containing much the same materials, has been much less metamorphosed, and may be of later age. Winchell and Grant state that the conglomerate seems to rest unconformably on the granite just northwest of Shoal lake.[46]

Granite and anorthosite eruptions of the region.

The eruptive masses rising through the Keewatin between Shoal and Bad Vermilion lakes consist chiefly of granite and anorthosite. They have been described by Lawson[47] and by Winchell and Grant, and were briefly taken up in the previous year's report of the Bureau of Mines.[49] During the last summer's visit the contacts of these two eruptions with one another and the surrounding schists were examined at numerous points, and a number of specimens secured, illustrating different phases of these rocks and their relationships.

The largest area of anorthosite encloses the southern arms of Bad Vermilion lake, and is broken by at least three masses of eruptive granite. Two or three miles to the west, on Seine bay, a series of points and islands of the same rock extends, with some interruptions, westwards along the southern

[44] Geol. Sur. Can., 1887, p. 84F.
[45] Geol, Sur. Can., 1887, p. 85F.
[46] Geol. and Nat. Hist. Minn., 1894, p. 66.
[47] Geol. Sur. Can. 1887, p. 99 F and 146 F.
[48] Geol. and Nat. Hist. Sur. Minn., p. 58.
[49] Bur. of Mines, 1894, p. 92.

shore of the bay for about ten miles. The rock is generally white, almost like crystalline limestone, with only a very small proportion of darker minerals occupying spaces between more or less perfect phenocrysts of plagioclase, ranging in size from a quarter inch to a foot in longest diameter. Towards the western end of Bad Vermillion there are points where the green constituent becomes more important, and the rock may be called a porphyritic gabbro.

Frequently portions of chloritic or sericitic schist have been enclosed by the anorthosite, showing its post-Keewatin age; and occasionally a green massive rock, apparently weathered diabase, is seen, perhaps representing dykes which have cut the anorthosite, but more probably fragments of Keewatin massive rocks swept off by the molten anorthosite.

Points of difference from typical anorthosites of eastern Canada.

While the rock is clearly an anorthosite, as was recognized by Lawson,[50] it presents some points of difference from the typical rocks of the name, as described so well by Dr. Adams,[51] the felspars being always white, never purplish in color, and comparatively rarely showing the sheared and granulated character so often found in eastern Canada. While more or less distinct cleavages may be seen in most examples of the Seine bay and Bad Vermillion anorthosite, the rock is generally badly weathered and comparatively few thin sections are fresh enough to show the twin striations well. The freshest example was obtained from a hill at the mouth of Seine river.

A study of numerous thin sections shows that the bulk of the rock, generally more than nine-tenths, consists of a very basic plagioclase, usually sprinkled with zoisite particles or completely changed into a saussuritic mass. The darker portions consist mainly of a fibrous or scaly mineral with parallel extinction, or nearly so, and low double refraction, probably serpentine, but perhaps a member of the chlorite group. Augite was found as a remnant only once, and then was not of the diallage type. The only other minerals observed are results of weathering, a little epidote along with the zoisite, probably also a little albite, and very small quantities of calcite.

The felspars, where fresh enough to enable one to study them, are found to range in angle of extinction of twins according to the albite law from seventeen to thirty-seven degrees; the average of a dozen measurements in thin sections from Bad Vermilion being about twenty-four degrees, and from the mouth of the Seine about thirty-two degrees. It appears then that the former felspar is bytownite and the latter anorthite, indicating a more basic felspar than that of the typical anorthosite, which Dr. Adams finds to be labradorite.[52]

The freshest section studied (783, mouth of Seine river), shows the felspar as large interlocking crystals, sometimes having intersecting sets of twin striations. The felspar individuals often show a thin band of fresh, clear felspar, where one joins the other; and when examined with a high power this clear felspar strip proves to be continuous with the individual to

[50] Geol. Nat. Hist. Sur. Minn., Bull. No. 8, 1893, Second Part, p. 7.

[51] Ueber das Norian, etc., Stuttgart, 1893; and Can. Rec. Science, vol. VI, No. 4, etc.

[52] Ueber das Norian, Separat Abdruch, Neues Jahrbuch für Min., etc., Bielagebaud VIII; and Can. Rec. Science, vol. VI, No. 4, p. 190.

which it is joined, but more acid in character, having extinction angles ranging from eight to fourteen degrees, corresponding to labradorite. In one case a bytownite crystal has been broken, the parts slightly shifted, and then cemented with labradorite, most of the twin lamellæ running across the clear strip of the latter felspar.

Analysis of the anorthosite.

As the freshest example of the anorthosite of the region, it seemed worth while to have an analysis made, the result being as follows in No. I. :

	I.	II.
SiO	46.24	54.45
Al_2O_3	29.85	28.05
Fe_2O_3	1.30	0.45
Fe O	2.12	.....
Mn O	trace	.....
Ca O	16.24	9.68
Mg O	2.41	.....
Na_2O	1.98	6.25
K_2O	0.18	1.06
CO_2	1.03	(H_2O) 0.55
	101.35	100.49
Spec Grav	2.85	2.69

For the sake of comparison an analysis of anorthosite from Rawdon, Que., is given in column No. II.[53] The low percentage of silica and of soda, and the high percentage of lime as compared with the anorthosite from Quebec will be noticed, the chief differences no doubt resulting from the fact that the Seine river anorthosite consists chiefly of anorthite, the Rawdon one of labradorite.

Analysis No. I was made by Mr. William Lawson, fellow in chemistry in the laboratory of the School of Practical Science, Toronto.

The specific gravity (2.85) is very high, perhaps because of the presence of considerable zoisite. The specific gravity of a specimen from Bad Vermilion lake was determined to be 2.76, corresponding to its slightly more acid character, consisting as it does of bytownite.

The most basic of the massive rocks.

The results of the analysis show that the anorthosite from the mouth of the Seine is one of the most basic of the massive rocks; and it is possible that its low silica contents and the fact that it consists essentially of anorthite instead of labradorite would justify a separation under a distinctive name; but there seems little doubt that numerous intermediate rocks, such at that from Bad Vermilion, link it to the typical anorthosite of the Province of Quebec. On the whole it will be wiser not to add another name to the rapidly growing burden of the lithologist; for it is clear that these rocks are not definite species, but shade into each other just as the plagioclase felspars do. Possibly a binomial nomenclature like that tacitly admitted in the classification of other rocks, such as the granites, might be adopted, the typical anorthosite being called labradorite anorthosite; that from Bad Vermilion lake, bytownite anorthosite; and the rock from the mouth of the Seine, anorthite anorthosite. The last term has however a very tautological sound. It is possible that more acid anorthosites corresponding to andesine, oligoclase or even albite may yet be found.

[53] Sterry Hunt as quoted by Adams, Neues Jahrbuch, Bielagebaud VIII, p. 494. Various other analyses are given on the same page.

The eruptive granites associated with anorthosite have been described by Lawson,[54] and Winchell and Grant,[55] and were referred to in the previous report of the Bureau of Mines,[56] and therefore do not require a minute discription here. The most easterly of the granite outcrops was not observed by Lawson, but is the most interesting of the three or more granite exposures, since it contains numerous gold-bearing fissure veins of great promise. The Bad Vermilion lake granites vary in grain from coarse to fine and are usually greenish, but sometimes flesh-colored. Under the microscope they are found to contain much quartz, generally broken or having undulatory extinction, a large amount of plagioclase associated with the orthoclase, and a little biotite or hornblende. Frequently the plagioclase is present in such large quantities as to make it doubtful if the rock should not be called quartz diorite. In many examples the dark minerals are weathered to greenish substances and the rock becomes protogine granite, all transitions being observed between quite fresh and greatly weathered portions. In the neighborhood of quartz veins the rock undergoes very marked changes, and at the edge of the vein becomes decidedly schistose. Examined with the microscope, felspar is seen to be largely or completely turned to decomposition minerals, especially sericite. All transitions between the unchanged granite and a quartz sericite schist may be observed; and one may conclude that there was great shearing and crushing action when the fissures were opened, the changes of mineral composition resulting probably partly from this and partly from the circulation of heated water.

Character of granite holding gold-bearing fissure veins.

In spite of the extensive metamorphism of the schistose selvages of the veins, the chemical composition of the rock has not been greatly modified, as will be seen from the accompanying analyses, No. I of the freshest granite observed, and No. II of a schistose example.

Analyses of the granite.

Specimen No. I (thin section 794) is flesh-colored and occurs on the road leading from Shoal lake to Island bay not far from the latter point. No. II (thin section 800) is greenish and sericitic and is the country rock of one of the quartz veins on AL75.

	I.	II.
SiO_2	76.20	72.23
Al_2O_3	14.41	16.43
Fe_2O_3	0.00	1.17
FeO	1.49	0.93
CaO	2.19	1.49
MgO	0.65	0.73
K_2O	2.44	5.13
Na_2O	3.32	0.54
	100.70	99.15
Spec. Grav	2.65	2.78

The analyses were made by Mr. William Lawson in the chemical laboratory of the School of Practical Science, Toronto.

The first specimen may be looked on as typical of the less weathered granites of this eruptive center. The high percentage of silica and the fact that soda is present in larger quantities than potash are the most prominent

[54] Geol. Sur. Can., 1887, p. 56F and 146F.
[55] (.. na . Sur., Minn., 1994, p. 58, etc. [56] Bureau of Mines, 1884, p. 89, etc.

points in its chemical composition. The second specimen is not quite characteristic of the selvage rock of the quartz veins, other examples showing more quartz. Its composition is that of a typical granite, in spite of the fact that the quartz is seen under the microscope to be crushed into fragments and the felspar completely changed to sericite. It is rather surprising to find so little soda in proportion to the potash. In that respect the crushed rock differs greatly from the fresh one, and is probably not characteristic. The sum of the alkalies is almost exactly equal to that of the fresh granite, suggesting that little or no alkali has been removed in solution.

Relationship of granite and anorthosite.

At several points, e.g., near the foot of Island bay, these granites contain angular fragments of green schistose-looking rock, very like some of the Keewatin rocks, but I observed no inclusions of the schist conglomerate. It looks at one or two places where granite and anorthosite come in contact as though the granite pushed apophyses into the anorthosite, and near the southeast shore of Island bay a portion of the latter rock appears to be included in the granite; but this relationship, on which Lawson and Winchell and Grant differ, I am not able to settle with certainty. At two places where granite and anorthosite come together a few feet or inches of dark green horneblende rock intervene.

A few dikes of felsite or microgranite cut the schistose and granitic rocks of the region, but none were observed in the anorthosite. Under the microscope none of these rocks prove to be true felsites, all being distinctly granular.

In addition to the massive rocks so far mentioned, some badly weathered diabases occur along side of the anorthosite, perhaps representing a third facies of magma belonging to this old eruptive center; but no point of special interest was observed in thin sections made from them.

Probable origin of the anorthosite and granite bosses, and its bearing on the persistency of veins.

Lawson looks on the anorthosite and granite areas as representing the base of a truncated boss which protruded through the lower part of the Keewatin, and suggests that they may represent the vent through which first basic and afterwards acid volcanic materials were poured forth, forming parts of the upper Keewatin.[56] If they are plutonic bosses, and not laccolitic as Lawson assumes in the case of the Malignites intrusive on Poohbah lake not far distant, there is every reason to believe that the gold-bearing veins cutting the granite may continue to great depths. The development work thus far done in the region shows no sign of their running out at a depth of two hundred feet.

Other Granite Bosses.

During the summer a similar association of fissure veins containing promising amounts of free gold with granite bosses pushing through Huronian (or Keewatin) schist was observed in various parts of the great archæan area of western Ontario; but anorthosite was found only at Bad Vermilion. On account of the economic importance of the gold-bearing fissure veins occurring in these granitic rocks, specimens from most of these outcrops have been studied and the more important instances will be referred to here.

[56] Geol. Sur. Can., p. 56 and 57 F.

At about the most westerly point in the Province, on Bag bay, an arm of a second Shoal lake near the border of Manitoba, very rich gold quartz occurs in what seems to be a wide and continuous vein in granite. Two specimens of the country rock prove to differ considerably. One consists of rather shattered quartz, little orthoclase and much plagioclase, often idiomorphic and having a zonal structure, with a considerable amount of brown biotite. Except for the color of the mica, this rock is very like many examples from the Bad Vermilion boss. The other specimen is red in color, and of a very different structure as seen under the microscope. The felspar is mainly orthoclase or microperthite and is greatly intergrown with quartz as micropegmatite, and the small amount of mica present is colorless. This is perhaps a dyke rock penetrating the other granite.

Granite of the Bag bay.

The next examples to be described were sent from the Regina mine on Whitefish bay, Lake of the Woods, a mine which is now a steady producer of gold. Of the three specimens sent, one is pale greenish in color and under the microscope is found to consist of much quartz, some weathered orthoclase and a large amount of somewhat idiomorphic plagioclase with a little muscovite. Though the rock looks quite unlike most of the Bad Vermilion granites, its general structure and mineralogical composition are closely like them. Another example is flesh-colored and schistose, and consists of crushed quartz and felspar largely changed to sericite. The third rock is quite unlike the others, and affords a fine example of micropegmatite with scarcely any mica. It is probably a dyke rock. I must thank Mr. Motley, who was in charge of the mine, for the specimens examined.

The Regina mine,

To the east of Bad Vermilion lake, at the Harold lake mine near the Seine river, we find gold-bearing fissure veins in a pale green granite or protogine, greatly weathered but still showing idiomorphic plagioclase with crushed quartz and sericite. The Sawbill lake quartz veins, which are of a promising character and will be worked next summer, also occur in a plagioclase granite of a very similar kind, sometimes sheared into a quartz sericite schist. The specimens examined were kindly furnished by Mr. Chewett, of Toronto.

the Harold lake mine and Sawbill lake regions.

It will be seen then that eruptive granites, unusually siliceous and rich in plagioclase, pushing through green Keewatin schists, contain auriferous fissure veins at a number of points in the west of the Province; and it is evident that such granite bosses deserve careful examination by explorers.

Eruptive granites deserve the attention of explorers.

Whether the granite itself is the bearer of the gold, which may then be looked on as laterally secreted in the veins; or the green schists supply the metal and the veins in the granite simply furnish a place of deposit from circulating waters, has not yet been determined.

Lake Superior Region.

It is altogether probable that in many localities beside the ones hitherto referred to, granite bosses will be found associated with gold-bearing veins. The only other instance studied by us is that of Jackfish bay, about a hundred and thirty miles east of the Sawbill lake instance. Here a large mass of granite and syenite interrupts the Huronian schists, and contains a small

Granite and syenite masses at Jackfish bay, north shore of lake Superior.

vein carrying free gold just where the railway bends westward from the shore of the bay. This was developed slightly some years ago by the Messrs. McKellar, but proved too small and pockety to be of value. The immense vein of gold-bearing quartz called the Empress mine lies in the schists a half mile north of this boss, and may have been influenced by its presence.

ROCKS OF JACKFISH BAY.

At the Jackfish bay station red syenite shows itself, the Huronian rocks being found a short distance to the northeast. It is a hornblende syenite containing much microcline and a little quartz, and is quite unlike any of the western granites so far described.

Near the Empress mine, three or four miles north of the station, and also on the west side of the bay, the rock is gray or faintly flesh-colored, and distinctly a granite. A microscopic examination proves that it resembles those previously described. Both sections examined contain much quartz and plagioclase, the latter often idiomorphic. Orthoclase is present in smaller amounts. The specimen from the railway cutting on the shore of the bay contains, as the dark constituents, much hornblende and a little biotite; the specimen from near the mine, only biotite. Titanite occurs as large brown crystals in each.

Dikes cutting the granite.

Some dikes that cut the granite near a tunnel on the west side of Jackfish bay were studied. They run about east and west and are well displayed as dark bands in the granite cliff. The widest is twenty-two paces across, medium grained and gray in color in the middle, compact and black at the edge. A thin section shows that the rock from the middle of this dike is quartz diabase, consisting of quartz, chiefly inter-grown with felspar as micropegmatite, plagioclase, common augite and biotite, the latter having a curious dichroism, red-brown and green with nearly equal absorption. Magnetite and slender needles of apatite occur as accessory minerals. The dark rock from the edge of the dike is very strikingly porphyritic in thin sections, slender laths or wider crystals of plagioclase and augite crystals or polysomatic masses lying in a very fine-grained groundmass consisting chiefly of augite, magnetite and minute plagioclase strips. Both augite and plagioclase exist then in two generations. The rock from the edge of the dike seems more basic than that from the middle, but no analysis was made to settle the matter quantitively. This dike has many points in common with some dikes in the Rainy lake region as described by Lawson.[57] A second dike is twenty-four feet wide, and consists of diabase of the ordinary type, free from quartz. The third dike is much narrower, being only three feet wide, and presents one peculiar feature, since it cleaves into thin plates parallel to the walls in which it is enclosed. Under the microscope it proves to be of the ordinary type, differing from the last only in containing some roundish masses of serpentine that may represent olivine.

SILVER ISLET ROCKS.

The Silver Islet dike.

Specimens were taken from the Silver Islet dike, which apparently was the silver bearer of that famous mine, since the vein was rich only in or near this dike. The rock is green gray, coarse-grained and somewhat variable in

[57]Geol. Sur. Can., 1887, p. 158 F, etc.

character. One specimen contains slender prisms of a mineral that at first glance suggests hornblende. Under the microscope one finds that the rock is a badly weathered quartz diabase. The hornblende-like mineral consists of serpentine, most of the fibers parallel to the longest axis, giving parallel or nearly parallel extinction. In places however the fibers are confused. No augite of any kind remains, serpentine and a little brown biotite replacing it. The felspar also is greatly decayed, though the edges are commonly somewhat fresh. The quartz sometimes occurs as quite large masses filling interstices, but is generally intergrown with felspar as micropegmatite. The quartz seems undoubtedly primary, showing no mosaic structure and containing the usual inclusions, apatite needles and cavities containing a fluid and bubbles.

A finer grained diabase, apparently part of a sheet, not a dike, was obtained at the village on the mainland opposite Silver islet. It is much fresher and of a quite different habit. The augite is purplish gray and not greatly weathered ; the plagioclase too is well preserved. Very little quartz occurs in this rock, and what there is shows hardly a trace of the micropegmatite structure.

The associated rock is a dark gray Animikie slate or shale, having no points of special interest.

Interesting Minerals.

In addition to the minerals mentioned in last year's report, two interesting specimens of minerals from the Lake of the Woods region have been given me by Mr. J. S. Whiting of Rat Portage. Native copper

One specimen consists of tiny but wonderfully perfect crystals of native copper from Andrew bay, Lake of the Woods. These crystals are all twinned octahedra or groups of such twins, the twinning being after the spinel law. Few of the crystals are more than an eighth of an inch long. They were picked out of a weathered schist, and are certainly the cleanest cut copper crystals I have ever seen.

The other specimen, which comes from Gold creek, Pine Portage bay, contains the rare silver telluride, Hessite, hitherto unknown in Ontario. The mineral occurs as lead gray plate-like masses with quartz and a very little pyrite and chalco-pyrite. An almost pure bit weighing .075 grams was analysed by Mr. Lawson with the following results : and Hessite.

Tellurium	35.40
Silver	61.01
Total	96.41
Specific gravity	7.968

No gold was found after precipitating the silver ; and the loss of 3.59 per cent. probably represents a little iron or copper pyrites. The small amount available for analysis prevented the determination of any other constituents. If we estimate the tellurium and silver found as representing the pure mineral, we get the percentage 36.67 Te, to 63.20 Ag, which comes very close to the theoretical composition of Hessite, Ag_2Te.

This is the third telluride thus far found in Ontario, sylvanite having

been reported from several points in the gold region west of lake Superior, and a telluride containing lead, probably nagyagite, having been obtained at the Huronian mine, as reported by Dr. Ellis of the School of Science, Toronto.

Since the account of the Ontario occurrence has been written, Hessite has been found in the Kootenay region in British Columbia, making a second locality in the Dominion for this rare mineral.

SECTION III.

A TOUR OF INSPECTION IN NORTHWESTERN ONTARIO.

WINDSOR TO FORT WILLIAM.

The route of all steamers of the Canadian Pacific Railway Co's lake line was until last year across Georgian bay, lake Huron and lake Superior, from Owen Sound to Fort William; but for part of the season last year one of the boats was put upon a new route, from Windsor to Fort William. As part of a larger scheme of exploiting some of the newer mineral districts in the northwestern regions of the Province, I had arranged with the Inspector of Mines to undertake a share of his duties by visiting mines and mining works on the Seine river and Lake of the Woods; and leaving Toronto by the Credit Valley division of the Canadian Pacific I got on board the Alberta (Captain McAllister) at Windsor, on Saturday, 10th August, having as companions Mr. John Cameron, of the London Advertiser, and my son. The day was intensely warm, and the run up by rail was more unpleasant than it might have been by reason of the clouds of dust which came pouring in at every open window. They will manage these things better in Bellamy's time; but they might be better managed in ours, as to dust at any rate, if not as to heat. Even on the steamers it is not always possible to escape the heat, for out in the midst of lake Huron next day men were uncomfortably warm in the lightest of summer clothes. Windsor to Fort William.

It was 3 o'clock in the afternoon when the Alberta left her dock, and the sun was beating down with a force which kept the mercury up in the nineties. "Bide a bit for lake Huron," the Scotch captain said; but the first breath of "caller air" was caught on lake Superior. There was no rush to get up the lakes however, for the berths of the Alberta were not more than half taken. Perhaps this was not so much because men and women did not desire a more congenial climate, as that they did not have the means to get away. It was a general complaint at the summer resorts of the upper lakes, I found, that tourists were much fewer than usual last year. On the Alberta.

The sail out of the Detroit river, across lake St. Clair and up the St. Clair river, is very pleasant, although the scenery is quiet. Many boats are coming and going, singly and in long tows—passenger boats, sailing vessels, whalebacks and steam barges, many of great size, besides tugs, yachts and launches large and small and suited to every need and taste.

Detroit's island park, which we passed to the left, has been very much improved during recent years, with walks, driveways, waterways, bridges, playgrounds, plantations of trees and gardens of flowers, and thousands of citizens flock to it for recreation in the warm summer days. Detroit's island park.

The canal at the mouth of St. Clair river, which I saw in course of construction thirty years ago, affords safe and easy passage for the largest boats on the lakes; yet it is none too deep for the present low level of the water. The canal in St. Clair river.

The work was undertaken by the government of the United States, although it now appears that it is in part if not wholly on the Canadian side of the international line.[1] Along the upper end rows of handsome cottages, with here and there club houses of imposing size, have been built on piles over the water, giving one an idea of Venice who never saw the city of the Doges. The mosaics and colors of the Venetian architecture are conspicuous enough in shingle and stain, and the long rows of columns and the loggia are not wanting; but the longer one looks at these houses on piles, the more they suggest an idea of the lake-dwelling age.

Sarnia's island park.

Stag island (Isle aux Cerfs) in the river St. Clair is Sarnia's park, and it is a very pretty resort. The lower two-thirds of it is wooded, and the upper end looks like a well kept lawn. A number of cottages occupy the east side close to the river; while on the Canadian bank were seen many camping parties in tents and cabins, and on island and mainland troops of children welcomed our boat with joyous shouts.

The Alberta called at Sarnia and tied up for an hour, taking on a few passengers and a large quantity of freight. The palace steamer Northwestern came in a few minutes later and crossed over to Port Huron, having left Detroit at 4 o'clock. She is a boat of graceful lines, and one of the swiftest on the lakes, yet it is doubtful if she is earning a dividend.

On lake Huron.

It was dark when the Alberta left Sarnia, and timid passengers were expecting a blow on lake Huron; but Sunday morning broke clear and warm, without a ripple on the water. A dim haze gave a weird effect to the many sailing vessels and steamers to be seen on every side of us, plowing their ways northward and southward and leaving no trace of a furrow behind.

Mackinac island.

Early in the afternoon we began to sight the Michigan shore, and at 4.30 we reached Mackinac island and learned that the Northwestern had come in at 9 in the morning. She had a start of half an hour at Port Huron: yet the run was made in seven hours' less time than the Alberta's, which two or three years ago was one of the fastest boats on the great lakes. The instance illustrates another revolution in rapid transit.

Mackinac has points of resemblance to Quebec. The town is on the lower ground, a few feet above the lake level. The fort crowns a high escarpment behind, its white walls, the officers' quarters, barracks and blockhouses presenting a very picturesque view. There are beautiful drives over the island, much of which is thickly clothed with cedar. Among the points of interest one should not fail to take in are the Natural Arch on a cliff through which

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[1] The boundary between Canada and the United States from the foot of lake St. Clair to the foot of lake Huron, according to the declaration and decision of the Commissioners of Great Britain and the United States under the sixth article of the Treaty of Ghent, 1814, respecting boundaries, and signed at Utica, 18th June, 1822, is described as follows:

" . . . To the northwest of, and near, the island called Isle à la Pêche, to lake St. Clair; thence, through the middle of said lake, in a direction to enter that mouth or channel of the river St. Clair, which is usually denominated the Old Ship Channel; thence, along the middle of said channel, between Squirrel island on the southeast, and Herson's island on the northwest, to the upper end of last mentioned island, which is nearly opposite Point au Chênes, on the American shore; thence, along the middle of the river St. Clair, keeping to the west of, and near, the islands called Belle Rivière Isle, and Isle aux Cerfs, to lake Huron."—Hertslet's Treaties, vol. IV, p. 497.

one sees a patch of blue water, and Sugar Loaf, which stands like a monument on the denuded plain of Upper Helderberg; old Fort Holmes on the tableland behind the highest escarpment, 300 feet above the lake, which the British and Canadians built and occupied in the War of 1812-15, and the battle-ground behind it where the Americans were put to rout; Lover's Leap and Pontiac's Lookout, on the cliff upon the south side of the island, and the elegant cottages and grand hotel along the drive down the slope to the village again. The island has had many ups and downs since the first Jesuit mission was planted there 225 years ago, but these are as nothing to the far more real ups and downs in its geologic history, so clearly revealed by the rock formations and the bold outlines of the wave-cut terraces.

Mackinac to Sault Ste. Marie.

The Majestic, of Collingwood, a new and fine steamer built for the north shore traffic, was at Mackinac before us, and we left together at midnight for Sault Ste. Marie. It was said that the two boats had raced over the same course on the previous trip and another trial of speed was expected this time, but if it took place the fact was hidden from the passengers. The Alberta took the new channel cut through on the American side behind Sugar island, which, besides affording deeper water than St. George's lake, shortens the distance several miles. She reached her dock at Sault Ste. Marie at 9.30 Monday morning.

The Canadian canal was not completed at that time, although the last touches were being put upon it; and so the Alberta had to await her turn to enter the canal on the American side. Owing to the enormous increase in the lake traffic, tedious delays have occurred at the Sault during recent years. Occasionally vessels have been detained ten or twelve hours, following a storm or fog, but the boat was fortunate which under the most favoring circumstances got through without a loss of four or five hours. It looked from the number of vessels waiting above and below as though we might not get away before three or four o'clock in the afternoon, and passengers betook themselves to see the sights of the place.

The Sault and the canals.

Several parties enjoyed the sensation of shooting the rapids in Indian canoes, if there be joy in getting within arm's reach of death of one's free will. Thirty years ago I one day took a stroll through the old cemetery of the Michigan town and came across the graves of a party of six men and women, lying side by side, and the record of the headstones told how they had perished together in an attempt to shoot the waters of the relentless Sault. That has been lesson enough for me; I get out of the wild river all the enjoyment I want from some safe point on terra firma.

The captain had warned us against going too far away, and on no account to think of doing the Canadian canal, as he would enter the lock at the first chance and wait not a minute for any man. A few of us therefore spent most of the time looking over the works of the new lock of the American canal, a gigantic enterprise now nearing completion. The walls of cut masonry are 45 feet high from the floor and 400 feet long, with a width of 80 feet, and the workmanship and the equipments are of the best which the wit of engineers can devise. This is no doubt the largest lock in America,

and perhaps in the world, but it yet remains to be shown that a larger number of vessels can be passed through it in the course of twenty-four hours than through the longer but narrower lock on the Canadian side of the river. This will be seen next year when the big lock is finished for traffic.

Out of the canal and up Whitefish bay.

At two o'clock in the afternoon, to the surprise of many, the Alberta got the call to enter, and soon she steamed out of the canal and on through the upper reach of the river into the wider waters of Whitefish bay. One whaleback with its nose deep in the water was met as we entered the bay, and another upward bound was passed. Barges with red iron stains on their sides were no doubt freighted with ore from the mines of Michigan, Wisconsin and Minnesota, bound for Cleveland and other ports on lake Erie. A large white steamer which had a mile the start of us out of the canal was overhauled and passed off Gros Cap, and the ease with which boats of every class were left behind proved how stanch and swift the Alberta is, compared with any on the lakes excepting the most modern.

A beaver farm on Isle Parisienne.

Isle Parisienne, a low-lying and densely wooded island in the bay to our right, is interesting as the seat of an experimental beaver farm. A colony of beavers was planted there in 1893 by Mr. Thomas Kirkwood, owner of the fine natural park on Point of Pines. In the spring of the following year none of the industrious animals were to be seen, and it was supposed that they had escaped to the mainland, the nearest point of which is about eight miles distant; but later in the year they were discovered with quarters established upon a little stream in the interior of the island. The result of this experiment will be awaited with interest, for if successful it may lead to the establishing of many beaver farms elsewhere under like conditions, and no other plan seems so feasible to save the beaver race from extermination. Isle Parisienne has an area of about 3,000 acres.

Caribou island.

Another interesting island lying near the route of steamers to Fort William, but out in the open lake, is known as Caribou island. It lies a little within the Canadian boundary as laid down by the Commissioners under the Treaty of Ghent; but being low it is not often noticed. This island was visited by Alexander Henry in 1771, and a very entertaining account of it is given in his book. It had been described to Mr. Henry by his Indians two years before while stationed on Michipicoten island (Isle de Maurepas) as covered by a yellow sand, which he was credulous enough to fancy must be gold. All that the Indians knew of it however was from the report of some of their ancestors, concerning whom a tradition had come down to them that, being blown upon the island by a storm, they had escaped with difficulty from the enormous snakes by which it was inhabited, and which were the guardians of the yellow sand. Mr. Henry was eager to visit so remarkable a spot, but was unable to do so until some time afterwards. He had discovered copper on the Ontonagan river in Michigan, and along the shore north of Point Mamainse on the Canadian side, and had made arrangements for the organizing of a company of adventurers to work the properties; but of course the island of Yellow Sands was the first in Mr. Henry's mind. The rest of the account is best given in his own words:

The interesting story of it told in Alexander Henry's Travels.

"In 1770 Mr. Baxter, who had sailed for England, returned, bringing with him papers by which, with Mr. Bostwick and himself, I was constituted a joint agent and partner in and for a company of adventurers for working the mines of lake Superior. We passed the winter together at the Sault de Saint Marie, and built a barge fit for the navigation of the lake; at the same time laying the keel of a sloop of forty tons. Early in May, 1771, the lake becoming navigable, we departed from Point aux Pins, our shipyard, at which there is a safe harbour, and of which the distance from the Sault is three leagues. We sailed for the Island of Yellow Sands, promising ourselves to make our fortunes, in defiance of its serpents.

A shipyard at Point aux Pins.

"After a search of two days, we discovered the island with our glass; and on the third morning, the weather being fair, steered for it at an early hour. At two o'clock in the afternoon, we disembarked upon the beach.

"I was the first to land, carrying with me my loaded gun, and resolved to meet with courage the guardians of the gold. But, as we had not happened to run our barge upon the yellow sands in the first instance, so no immediate attack was to be feared. A wood was before us at some little distance from the water's edge; and I presently discovered the tracks of cariboux.

"Soon after I entered the woods, three of these animals discovered themselves, and turning round, gazed at me with much apparent surprise. I fired at one of them and killed it; and at a mile further I killed a second. Their size was equal to that of a three-year old heifer. The day following I killed three.

"The island is much smaller than I had been led to suppose it; its circumference not exceeding twelve miles. It is very low, and contains many small lakes. These latter I conjecture to have been produced by the damming up of the streams by beaver, though those animals must have left the island, or perished, after destroying the wood. The only high land is toward the east.

"A stay of three days did not enable us to find gold, nor even the yellow sands. At the same time, no serpents appeared, to terrify us; not even the smallest and most harmless snake. But, to support the romance, it might be inferred that the same agency which hid the one had changed the other; and why should not the magic of the place display itself in a thousand varied exhibitions? Why should not the serpents have been transformed into hawks? And why should not the demons delight in belying every succeeding visitor, by never showing the same objects twice? Sure I am, that the hawks abounded when we were there. They hovered round us and appeared even angry at our intrusion, pecking at us, and keeping us in continual alarm for our faces. One of them actually took my cap from off my head.

Exploding the romance

"On one of the lakes we saw geese; and there were a few pigeons. The only four-footed animal was the caribou, and this, it is probable, was first conveyed to the island on some mass of drifting ice. It was however no new inhabitant, for, in numerous instances, I found the bones of cariboux, apparently in entire skeletons, with only the tops of their horns projecting from the surface, while moss or vegetable earth concealed the rest. Skeletons were so frequent as to suggest a belief that want of food in this confined situation

Graves of the caribou.

had been the destruction of many; nor is anything more probable; and yet the absence of beasts of prey might be the real cause. In forests more ordinarily circumstanced, the graminivorous animals most usually fall a prey to the carnivorous, long before the arrival of old age; but, in an asylum such as this, they may await the decay of nature.

"The alarm of these animals, during our stay, was manifested in the strongest manner. At our first arrival, they discovered mere surprise, running off to a distance, and then returning, as if out of curiosity to examine the strangers. Soon, however, they discovered us to be dangerous visitors, and then took to running from one place to another, in confusion. In the three days of our stay, we killed thirteen.

"The island is distant sixty miles from the north shore of lake Superior. There is no land visible to the south of it, except a small island, on which we landed."

From the situation of the island as described by Henry, as well as from the fact that numerous caribou were found upon it, there can be no doubt that it is the one now known as Caribou island.

Alone on lake Superior.

It was five o'clock when we passed between Whitefish and Mamanise points into the wide waters of lake Superior, and soon the Alberta steered a course to the north-westward, away from the track of the fleet employed in the trade of the numerous ports on the American shore of the lake. There was not a craft to be seen when darkness closed around us; yet if the promenade of the hurricane deck was all but deserted, it was not so much that we had lost sight of sail and land as that only the more robust of the passengers could stand the change of temperature in the open air, as indicated by a fall of more than 30° in the thermometer since Sunday noon on lake Huron.

We were told on leaving the Sault canal that we might not reach Fort William until two p.m. Tuesday, but the boat made such good headway during the night that the point of Thunder cape was passed at seven in the morning, and after making a call at Port Arthur she tied up at her dock in the Kammistiquia river at 9.30, half an hour ahead of the schedule time, having made the run from the Sault canal in $19\frac{1}{2}$ hours.

An Excursion south of Savanne.

Reports of recent gold discoveries east and west of Fort William.

At Fort William I met Peter and John McKellar, who informed me of a recent discovery of gold near Jackfish bay on the north shore of lake Superior, which they had prospected and had found the vein to be twenty feet wide

[2] Travels and Adventures in Canada, by Alexander Henry, pp. 226-230. Mr. Henry was familiar with Captain Jonathan Carver's Travels, who he says learned something of the fables of the yellow sand, though he places the treasure upon the Isle de Maurepas (Michipicoten). "One of the Chipeways told me," Carver wrote, "that some of their people were once driven on the Island de Maurepas, which lies to the northeast part of the lake, and found on it large quantities of heavy, shining, yellow sand, that from their description must have been gold-dust. Being struck with the beautiful appearance of it, in the morning, when they re-entered their canoe, they attempted to bring some away; but, a spirit of amazing size, according to their account, sixty feet in height, strode into the water after them, and commanded them to deliver back what they had taken away. Terrified at his gigantic stature, and seeing that he had nearly overtaken them, they were glad to restore their shining treasure; on which they were suffered to depart without further molestation. Since this incident, no Indian that has ever heard of it, will venture near the same haunted coast."

and a mile in length, yielding gold in paying quantities clean across. They had procured a survey of three locations and hoped to more thoroughly explore them during the fall with a view to organize a working company. They also suggested that I should visit the Quartzite mine near the Mattawin river, which was reported to be an extensive ore body of country rock assaying $6 to $8 per ton. I went over to Port Arthur by the tramroad and saw Crown Timber agent Munroe, with whom I arranged to visit Silver Islet and the Black Bay region upon my return from the west.

A telegram and letter received from Dr. Coleman at Savanne informed me that he was in camp there, having just arrived from Rainy lake, and was ready to start on a projected week's exploration of the lake Shebandowan country, which we had previously planned to make together. A quantity of supplies was purchased for this tour, as suggested by Dr. C., and everything was made ready to take the first train for the west. Dr. Coleman's party at Savanne.

The railway time goes back an hour at Fort William, where the Canadian Pacific enters upon the 24-hour system, and the hours from noon to midnight are counted as from 12 to 24 o'clock. Our train was an hour late, and did not leave until 23 o'clock. Savanne was reached at 1.45 Wednesday morning, and there being no hotel accommodation in the place the station master kindly provided beds.

I rose at 5.30 and walked down to the Savanne river, a quarter of a mile south of the station, where Dr. Coleman and his party had pitched their tents. The forenoon was occupied in completing the outfit for our excursion to lake Shebandowan. A shower of rain fell in the morning and the wind rose, which made the start uncertain, but at 12.30 p.m. we broke camp and left at a venture, with four canoes and a party of eight, including two guides and a cook.

ON LAC DES MILLE LACS.

The Savanne river is sluggish, with reedy banks all the way to its mouth, a distance of two miles from the station. The bay into which it empties—one of the innumerable arms of Lac des Mille Lacs—is about a mile wide, and on the north side of it is the new saw mill and buildings in course of erection by the Savanne Lumber Company. On the south side is a low rocky point covered with small birch. The lumpy reddish-brown waters of the bay gave a hint of what might be looked for in the open lake, which we entered around the point with a head sea on. We made west for Birch island, where there was an Indian encampment, and having bought some whitefish we took thence a course south towards Sand point, keeping for safety as well as we could in the shelter of the islands. It was four o'clock when we reached the point, although the distance from Savanne was not more than ten miles by the course we took, but as the wind was rising and the waves were breaking violently over the spit which here extends nearly across the lake, it was not deemed safe to venture into the wider reach of waters beyond. Savanne river to Sand point.

There was another reason, too. Bread was required for next day's rations, and no place is so favorable for the successful baking of it as a

An out-of-doors culinary outfit.

good sand beach. A tin oven (the Connecticut baker of our boyhood days) is good enough for a small loaf or a pan of cakes or buns, and we had one of them ; but to bake a fifteen or twenty-pound loaf for a camping party there is nothing so suitable as the old-fashioned round and flat-bottomed cast-iron pot with a cast-iron lid, such as our mothers used in the wide old-fashioned fire-place of the log cabin, before the days of the cooking stove. Well, our Indian cook having first built a hot fire on the sand, and having got through with the preliminaries of mixing, setting and kneading, draws the fire at one end, scoops a hole into the now thoroughly heated bed for the pot, which is deposited with its charge of light and spongy dough and carefully covered with the lid, piles the hot sand all around and over the pot, and sits down like a Stoic until the big brown loaf is done and well done. Perhaps it was the strong baker's of the Manitoba No. 1 hard, or the cooking in the old-fashioned pot, or maybe the appetite which comes to one who lives and works and sleeps in the bracing air of our northern woods ; but surely no more toothsome bread has ever been baked than that which our Indian cook supplied from his improvised oven in the hot sands.

An Indian garden.

A portion of Sand point was occupied last summer as a garden by one of the Indians of the Poplar Point reserve, which village may be seen about a mile and a half beyond, towards the south. It had a promiscuous crop of potatoes, cabbage, beets, peas and beans, and although the soil was not rich all were growing thriftily.

Aboriginal remains unearthed.

A path leading from the garden towards the village was followed about a hundred yards south, to a spot where Dr. Coleman had discovered a skeleton four days before, on his way up the lake. It was exposed in the face of the bank, which is gradually being cut down by the action of the water, and the doctor had carried away with him the skull, leaving the rest of the skeleton intact. The skull was large and round, with an oblong hole on the right side above the ear, the result very probably of a blow from a tomahawk or other lethal weapon. The front teeth were worn down, but were otherwise sound and well preserved. The body had been buried in a sitting posture, facing the south, in a bed of gravel about three feet below the surface and fifteen feet above the lake. Below it to the water's edge was a bedded deposit of fine sand. We removed the remaining bones with the help of a pick, and from the measurement of the thigh and shin bones it is estimated that the man when living stood not less than six feet in height and possibly six feet three inches. The vertebræ were disjoined, and the pelvis bones were decayed. Fragments of pottery were found with the body, the rim with markings on the outer side ; the inner surface was of a bright red color and the vessel had apparently held small pieces of red pigment.

The Indian reserve at Poplar point.

Our camp was astir Thursday morning at six, we breakfasted at seven, and although the headwind was still fresh our flotilla of four canoes set out across the bar, taking a southwesterly course down the lake. We called at Poplar point to pay the owner of the garden for a supply of potatoes and other vegetables taken at Sand point. There are about one hundred Indians at this reserve, and twice as many dogs, and the whole village gathered around

us for a pow-wow. Among the rest was Chief Peter, who walked over from his teepee with the looks and air of a patriarch. He has long white beard and moustaches and shaven cheeks, and although his figure is slightly bent he is strong and vigorous. Peter told us that he is a hundred years old, but he does not appear to be more than seventy-five. He has great-grand-children twelve years old, and children younger than they, for he has been three times married, and has two wives living with him now, one of whom was an adopted daughter. Chief Peter does not know when his people came to live at Poplar point; his father had been born there, and his grandfather; his people had always been there. They are pagans on this reserve, and do not want to be anything else. Chief Peter had noticed that Christian Indians would not work, "too much soul," and (a good St. Paul rule of which this Peter had likely never heard) if one did not work he should not eat, and "Injun bakadé (hungry) all the time." The Roman Catholics had desired to establish a mission and a school on the reserve; but while the Indians were willing enough to have a school they objected very decidedly to a mission, saying that it would bring about divisions among their people, and they wished to be all as one. A number of years ago the Minister of Indian Affairs made an attempt to teach them agriculture, to which end he made the band a present of a bull, a cow and an ox, and sent a halfbreed to instruct the Indians how to plough the land. The three animals were hitched together to the plough, but when the day's work was done and they were loosed, the bull swam out into the lake and was drowned. Such is the story as told by one of our guides, but possibly with humorous exaggeration. It is certain however that these Indians do not take kindly to the ways of civilized men, for the bark-covered teepees are preferred to the log houses which have been built for their greater comfort.

Chief Peter.

Our course from Poplar point was westward about two miles over lumpy water and then southward three miles to the southeast bay of Lac des Mille Lacs. To the right are seen the remains of a dock, and one who did not know anything of the history of the country might wonder what had led to the building of a dock in such an out-of-the-way corner of our country.

A relic of modern history.

The route of trappers, hunters and factors in the palmy days of the Hudson's Bay and Northwest Companies was from the Savanne river across Lac des Mille Lacs and the Baril portage, and thence by many lakes and stretches of river into the southeast arm of Rainy lake. The southeast arm of Lac des Mille Lacs leads into this route, but it formed no part of it; and indeed the fur-traders needed no substantial dock-works for their fleets of canoes. We have only to go back a quarter of a century to learn the story hinted at by the broken down dock. It is told in the annual reports of the Department of Public Works at Ottawa, under the title of the once familiar Dawson Road route, which for seven or eight years, beginning with 1870, was the great highway from eastern to northwestern Canada. There was a well-graded road from Port Arthur (or Prince Arthur's Landing as it was then called) to the foot of lake Shebandowan, a distance of 45 miles. Then there were small steamers or tug-boats and barges on the lakes, with well-equipped portages where these were required, which conveyed passenger and freight

Old route of the fur-traders,

and the Dawson Road route.

traffic with expedition from east to west and west to east. On Lac des Mille Lacs the Dawson route joined the old route of the fur-traders towards the west, and besides providing a highway for settlers going from the older Provinces into Manitoba and the Northwest Territories, it gave comparatively easy access to sections of the Canadian Pacific Railway, then under construction, at Savanne and Rat Portage. As evidence of the traffic on this line it may be stated that from 1st July, 1875, to 30th June, 1876, there were carried over it 2,172 passengers and 1,107 tons of freight. The total length from Prince Arthur's Landing (Port Arthur) to Fort Garry (Winnipeg) was 452 miles, including from the foot of lake Shebandowan to the Northwest Angle of Lake of the Woods $303\frac{3}{4}$ miles of navigable waters, and eleven portages with an aggregate length of $8\frac{1}{3}$ miles. The dock we had just passed was at the end of the second of those portages, numbered from the east.

BACK INTO THE ST. LAWRENCE BASIN.

Across a portage into St. Lawrence waters.

We paddled up into a grassy stream, at the foot of a rounded hill of Huronian slates into which were cut the initials and names of scores of people, most of whom had doubtless been passengers bound for the Northwest, as the dates were in the early seventies; but there were also the names and initials of some well known explorers. Here we had dinner, and then packed across the portage to Kashabowie lake. This portage is a mile long, and it crosses the height of land separating the St. Lawrence and the Nelson river basins; yet there is little difference in the levels of the two lakes, and the land does not rise above them anywhere more than fifteen or twenty feet. The road had been well built, but it is now grown up with bushes, and only a footpath remains. At the Kashabowie end is a small clearing partly covered with scrubby trees, for the poor sandy soil does not favor a thrifty vegetation. It had probably been occupied by the dwellings and stables of the men who attended the portage, but no signs of a building are visible; or it is better to say that I saw none. The dock is fallen to pieces, and the charred ribs of a boat are standing out of the sand. We had an overpowering stench of skunk here, and walking along the sand beach some fifty yards I discovered the fragment of a skunk's skin which the waves had washed up, and which no doubt was the source of all the odor that filled and fouled the air. A rose bush in full bloom would not be detected by its odor at one-half the distance.

Kashabowie lake.

The water of Kashabowie lake is as clear blue as that of lake Superior itself, and is in this respect a very agreeable contrast to the water of Lac des Mille Lacs. It is a very irregular lake, contracting into river-like channels and expanding into wide stretches, with long arms extending in several directions. There are a number of islands, some of which are beautifully clothed with spruce and birch and a carpet of deep green moss. The waterlines on the rocky shore show at least two permanent levels of water, one three feet and the other six feet above the present level. The lower of these is probably the mark of high water in spring and early summer, and the higher one the mark of water during the maintenance of the Dawson route, when the outlet was raised several feet by a dam.

The length of Kashabowie lake, on the authority of Dawson's report, is nine miles, but nearly twelve according to Proudfoot's measurement, and the length of the portage to Shebandowan lake is three-quarters of a mile. This portage is graded up like a railway track, and is yet in excellent condition. Kashabowie river leaves the lake by two channels on the east side of the portage road, which soon unite. Its stream is a succession of rapids and falls, and at Shebandowan lake is a fall of seven or eight feet which has cut back a gorge perhaps seventy-five yards from the lake shore line.[3]

Portage to Shebandowan lake.

At the foot of Kashabowie portage, which is the first on the Dawson route, is a clearing of about an acre in extent, and here we encamped on Thursday night. The once substantial buildings of squared timber are now thrown down to the foundations. The site they occupied is very charming, and would be an ideal spot for summer cottages, with a rising background of green timber, the noisy river flanking it upon the left and the beautiful lake Shebandowan[4] studded with islets in front.

Camp on lake Shebandowan

We met a party with Mr. James Hammond, of Fort William, and Mr. Russell, L. S., of Port Arthur, just returned from surveying eight mining locations, after having been out three weeks. They too were pitching their tents on the bank of the lake for the night, and after talking over our plans Mr. Hammond agreed to go back with us next morning to the Huronian mine, near to which his own work of exploration had been carried on since early spring. He had discovered gold in quartz veins and gold also, he believed, in quartzite or country rock at several places east and southwest of Moss township, and was elated with the promise of the district as a prospecting field for minerals. It was also arranged that upon returning from the Huronian mine Mr. Hammond should accompany us to visit a number of iron locations on the Mattawin range, and gold locations on Gold creek, southeast of lake Shebandowan.

Arranging to visit Moss township and Mattawin river.

A CANOE TRIP TO ROUND LAKE.

Friday morning, August 16, a party of eight left camp at seven o'clock with three canoes and paddled to the extreme west end of lake Shebandowan, a distance of about eight miles. There are numerous islands in this part of the lake, most of them covered with timber. Along the north shore the trees are mostly spruce and birch, growing close down to the water's edge, but in places the fire has made ugly gaps. At the west the lake is narrow and

Lake Shebandowan to Round lake.

[3] The distances as laid down on Hume Proudfoot's MS. map in the Crown Lands Department (1892) from the railway crossing of the Savanne river to lake Shebandowan (measured on the ice) are as follows:

	Chains.
On Savanne river to its mouth	189.00
On Lac des Mille Lacs to Sand point	383.41
" " portage	405.86
On portage to Kashabowie lake	76.56
On Kashabowie lake	933.36
On portage to lake Shebandowan	60.00
Total	2,048.19

The whole distance from Savanne to lake Shebandowan by this route is therefore about 25½ miles.

[4] The Indians pronounce it Sheb-an-do-wan', with the accent on the last syllable.

shallow, and saving the winding channel of a creek which enters at the extreme end it is covered over with coarse grass and lily-pads. Up this creek through a slush of water and peat the canoes were poled to the shore. Then followed a portage of over a half-mile to Mink lake, where had once been a road, but now there is nothing but a poorly beaten path winding in and out through a thicket of bushes.

Experience on a portage.

Imagine yourself fresh out of an office, carrying one end of a heavy canoe, the sharp edge of the keel resting on your shoulder, and a well-hardened man at the other end making the pace for you at three miles an hour or better: then you can appreciate the innocent idea of a nice summer outing for a civil service man bent on seeing our mining regions. The man who will carry a pack of 75 to 150 pounds or the end of a built canoe across a trail half a mile or a mile long, clambering up and down high ridges of rock, picking his way through bog or muskeg, striding over fallen timber, and getting wet to the skin should he strike a portage after a shower of rain, does not find any recreation in the business. It is downright hard work, and until the sinews are hardened and the appetite sharpens to a diet of bacon and beans he will vote it a distressing effort every time.

Mink, Silver, Duck and Round lakes.

We made the portage to Mink lake in fifteen minutes, and crossed that pretty little lake just in time to get under the canoes for shelter from a dash of rain. A short portage brought us to a long narrow body of water known as Silver lake, on the shores of which there were signs of moose, the first we had seen since starting out. A paddle of two hundred yards brought us to the third portage, which proved to be a long, rough and hard one, as well as wet after the rain. The one great joy of it was to see a glint of water through the trees at the end. This is Duck lake—so called, Mr. Hammond says, because no ducks are ever seen upon it. It is a fine sheet of clear water, about three-quarters of a mile long, closed in on all sides with a dense forest. At the farther end is a portage to Kawawiagamog or Round lake,[5] and to reach it the trail crosses a rocky ridge which rises to a height of about 100 feet above the plain. Two canoes were taken across the portage, and we made a permanent camp on Round lake upon a very beautiful site in a grove of tall pines, with a wide sand beach extending in front along the eastern shore of the lake.

Mining locations at Round lake.

The afternoon was spent in examining a number of locations east of the lake, and along its western and northern shores, particulars of which are given by Dr. Coleman. Location 65K was taken up in 1876 by J. McNaughton, John McMillan and Daniel McFee. It is crossed by a mineral belt about 500 feet wide containing rich copper pyrites, a greenish-colored ore said to carry a low percentage of nickel, and ores which are reported to yield gold and platinum. Messrs. Hammond and Folger now own a two-thirds interest in this property, and one-third is held by the trustees of the McMillan estate. On the northwestern side of the lake is a location surveyed recently

[5] This lake is only circular upon the west and north sides; on the south side a peninsula extends out some distance, having a length of half a mile or more from east to west; the east side has an irregular outline. Mr. Hammond's Indian, George, told us the name should be uttered as one long guttural, with the lips well rounded and not once closed,—a sort of Indian shibboleth, it may be.

for Mr. Hammond, the country rock of which is charged with iron and copper pyrites and is said to be gold-bearing. Analyses procured by Mr. Hammond are claimed to run as high as $7 to $8 per ton in gold. The ridge on the mainland south of the peninsula, we were told by Mr. Hammond, is composed largely of red granite.

A thunder storm on Round lake.

We had an experience during the afternoon of one of the thunderstorms for which this region of country has long been famous. A dark cloud which rose out of the west had been threatening us for half an hour, and then seemed to part towards the south and north. Quickly however it came together over our heads; there were almost incessant flashes of lightning and claps of thunder; the wind blew with the force of a gale; and the rain swept over the face of the water in solid sheets. Such a dark, pelting, driving storm I have not witnessed elsewhere outside of the cyclone belt of the west; we had experience of another like it a few days later on the Mattwin river; and according to reports such storms are of frequent occurrence over that high tableland in which headwaters of the St. Lawrence and Nelson river systems have their source. We were dry enough upon shore, under cover of the canoes; but it was not pleasant to think that a tree might be blown down upon us in a woods recently fire-swept, or that a thunderbolt might crash into our midst out of the surcharged clouds. We got back to camp safely, but not without experiencing what a kittle thing a canoe is upon the water in a gust of wind.[6]

THROUGH MOSS TOWNSHIP.

The winding Kawawiagamog river.

The wind moaned through the pines all night, the waves beat a monotone upon the sand, and a heavy shower of rain fell; but Saturday morning broke clear and cool, and we rose at five to make an early start for the Huronian mine. The wind had fallen, and these small lakes, so easily ruffled, are quick to subside. We canoed about two miles west to the outlet of the

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[6] A description of one of these storms on Lac des Mille Lacs is given by Captain John Palliser in his Journals of Exploration of British North America under date of June 25, 1857. "Entered the Lake of the Thousand Isles (*sic*) at five o'clock. The air was hot and sultry, and the dense clouds lowering to the southwest betokened a coming storm. We coasted along the south shore of the lake, which is low, with protruding round masses of rock covered in some places with rough sandy gravel, till making for one of the many thickly-wooded islands we landed and encamped for the night. Night brought with it a violent thunderstorm, accompanied by magnificent lightning; its flashes were repeated at intervals of only a few seconds, and its headed appearance resembled the discharges of a monster Leyden jar." (p. 26.)

Henry Youle Hind in his Narrative of the Canadian Red River Exploring Expedition of 1857-8, vol. I, p. 54, also describes a storm on the same lake, occurring seven weeks later in the same year. "At our camp on the Height of Land (Aug. 12) an atmospheric phenomenon of singular beauty occurred. The night was very beautiful and calm. The moon shone with great clearness and brilliancy, and numerous meteors darted through the sky in the south and west. Early in the morning, before daylight, I noticed a distinct arch of what at first sight I mistook for an aurora, but, observing its position to be nearly due west, referred it to very elevated clouds illumined by the sun's light. Its appearance was like that of a dim auroral arch, well defined, and forming a complete segment of a circle to the height of forty-five degrees, its form being persistent as long as observed. The remaining portion of the sky was clear, the moon and planets shining at the time with a very brilliant lustre. It occurred to me that it might be the forerunner of a storm, an idea which the rising sun, lighting up the tops of the trees beneath a perfectly cloudless sky about an hour afterwards, banished for a few hours. Towards noon the sky became overcast from the southwest. About half-past three thunder was heard in the distance, and at four scud from the southeast began to traverse the sky. At five p.m. the clouds in the southwest presented a very magnificent spectacle; they seemed like gigantic waves setting towards the northeast. This wavelike appearance occurred in different parts of the heavens, and almost every variety of cloud

lake, a small stream known as Kawawiagamog river. For the first mile of its course, or until it enters Cross lake, this river is a series of rapids, falling about twenty feet. There is a rough portage through the woods to Cross lake, the whole length of it being strewn with angular boulders. The lake is only a half-mile long, with rock forming the shores of the upper and marsh the shores of the lower end. Doubtless it at one time had a length of several miles, but the basin has become filled with silt and vegetable mould and now sustains a vigorous growth of coarse grass.

A bright little stream from the south, the outlet of Twin and Fountain lakes, joins the Kawawiagamog a short distance below Cross lake, where the river channel narrows to eight or ten yards and deepens to three or four feet, and thence meanders in a southwest course through Moss township a length of about five miles (but only two miles in a straight line) to expand again into Grass lake. In this distance there are 134 bends in the stream, most of which are of sixty to ninety degrees, and where the turns are so many in so narrow a channel the canoeman must be always alert if he would keep the prow of his craft out of the muck. A canoe indeed requires to be watched every moment: it is the most manageable of little boats, if one knows the art of management, and it responds instantly to every move and poise of the paddle; but it is also liable to go wholly and disastrously wrong if vigilance be relaxed only a moment. Our men were skilful and vigilant, and there was no mishap.

Moose and duck.

The marsh through which the river flows is about a half-mile in width—in some places less and in others more—and the luxuriance of the vegetation probably makes it fine feeding ground for moose. The trails of these animals down to the water were observed at a number of points, and looking at the boggy nature of the ground one wonders how they escape being mired. But the moose possesses great strength, and its wide spreading hoofs furnish a relatively good support upon the network of roots of the grasses and plants which grow so rank in a peaty soil. Wild rice is plentiful in the shallow

passed in review. A few minutes before five p.m. a very long and vivid flash of lightning shot across the sky in a direction from south to north, succeeded by a distinct snap like that produced by an electrifying machine. About ten seconds afterwards the loud rolling thunder recorded the flash, and at five p.m. the rain commenced; the lightning was intensely vivid, and the thunder unusually loud."

Another account of a storm is furnished by Wolseley in his Narrative of the Red River Expedition of 1870, first published anonymously in Blackwood's Magazine for December, 1870, and January and February, 1871, and subsequently with the author's name as No. II in the series of Travel, Adventure and Sport. The little army was encamped near McNeil's bay at the foot of Shebandowan lake, awaiting the transportation of eighteen miles by water to the portage across to Kashabowie lake. "Strong westerly winds prevailed on lake Shebandowan whilst the final arrangements were being made for our start, so that upon some days such a sea came rolling in and breaking upon the shore that it was impossible to load boats, or to get them off had we even succeeded in equipping them. Most fortunately these 'blows' seldom became powerful until about nine or ten a.m., and generally wore themselves out towards four or five p.m., so that we had always several hours in the morning and evening for pushing on our work. On the night of the 15th July we had the most violent thunderstorm experienced during the entire operation. The heavens seemed at times as if to open and let fall great crushing weights of exploding substance upon the earth beneath, which they struck with blows that made all nature shake and tremble. Then followed what is commonly known as rain, but which in this instance was as sheets of water tumbling upon us in rapid succession, beginning suddenly and ending as abruptly." (p. 266.) Previously in the same Narrative (p. 240) Wolseley writes: "Of all known parts of the world it may be truthfully stated that the Thunder Bay region is the most subject to violent thunder storms—whether owing to metallurgic influences or to geographical position we do not know. Many officers who had been 'all over the world' admitted that they had never heard such appalling claps of thunder before. On some occasions trees were blown down, and on others they were split into shreds. At times, especially at night, the noise was such that the ground seemed to shake, and it sounded so close that one expected to see the tent-pole riven in two."

waters of Grass lake, and ducks as well as moose haunt them to feed upon the heads of grain. It was noticed in Silver lake that moose had grazed the rice crop so close that hardly a spear was to be seen above the water.

Grass and Jackfish lakes.

From Grass lake there is a portage of about 200 yards towards the northwest through timber to Jackfish lake. This is a fine sheet of clear water, irregular in shape, a mile wide, and two or three miles long, draining into Grass lake, and is thickly wooded on all sides. From the farther side, about two miles from Grass lake portage, a road leads over low ground about a mile and a half to the Huronian mine. It was well constructed, although corduroyed for a large part of the way; now it is grown up with bushes, and only a path remains. The Jackfish lake end of it was only built so that pine logs cut around the shores of the lake might be drawn to the saw-mill at the mine. The road proper started at the west end of lake Shebandowan and ran northwestward between Round and Twin lakes, thence westward across the narrows of Cross lake, through the timber north of Kawawiagamog marsh, and between Grass and Jackfish lakes to the Huronian mine, a length of thirteen miles. In 1887 the Government built a road from Baril portage on Lac des Mille Lacs, a distance of fourteen miles southward into Moss township, at an expenditure of $8,456, leaving the owners of the mine to build the remaining section of five miles to their property. From Savanne to Baril portage there is uninterrupted navigation for tugs and small boats, and the new road would doubtless have greatly facilitated the operations of the company had not other causes interfered to bring their enterprise to an end. "The first seven miles of road made are through a rough, broken country, but the remaining distance is through a better district, containing some very fair agricultural land."[7] The terminus is about one mile south of Iron lake, in Moss township.

The Huronian mine roads from lake Shebandowan,

and from Baril portage.

THE HURONIAN MINE.

First discovery of gold in Moss township.

The first discovery of gold in this region was made in 1871, when a location numbered H 1, containing 160 acres, was surveyed, and on 7th November a patent was issued therefor to one Neil White. Many other locations were taken up subsequently along the same range of green Huronian schists, the strike of which is northeast and southwest, but it was not until 1875 that the township was laid out.

Huronian mine location.

Huronian mine, originally known as Jackfish mine, is on H 1. Entering upon the location by the road from Jackfish lake, one ascends through coppice and briers to a naked ridge of rock which extends in a southwesterly direction, with a valley or gorge on either side converging with their tiny spring-fed streams at the stamp mill about 300 yards farther west. From the highest point here the eye takes in an area of thirty or forty acres, over which the timber had been cut when developing and mining operations were carried on, but which is now covered with second growth. A frame building in front was the manager's office and quarters, with the assay office just beyond it; while to the right is a long low-roofed log building which had

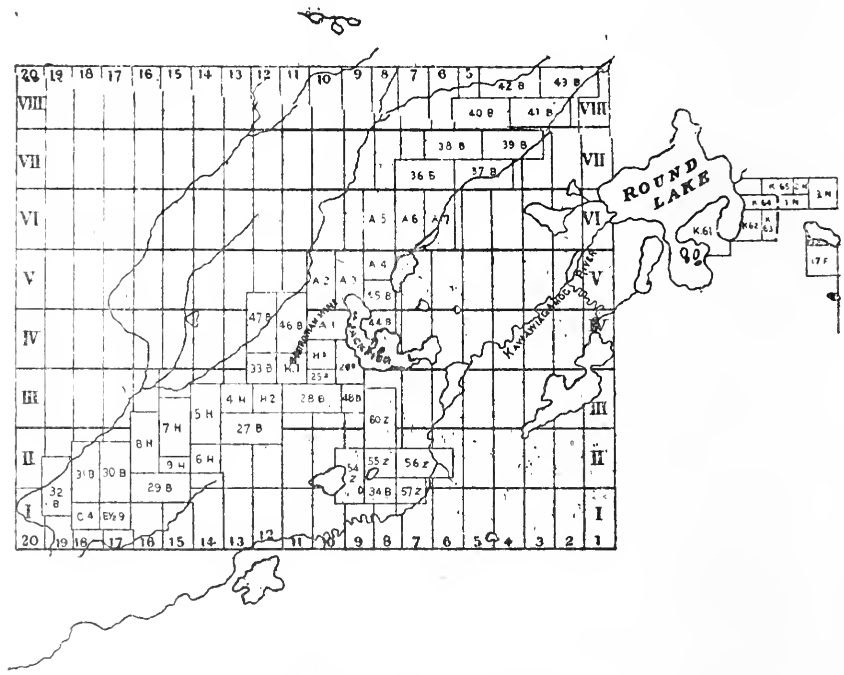
Offices and buildings.

[7] Report of the Commissioner of Crown Lands, 1887, p. 54.

been occupied as the company's store, besides stables and other buildings. Down in the narrow dell upon the north side, now secluded in the second growth, is a cluster of log huts which, no doubt, had furnished quarters for employés; on the right, looking down stream, a solid wall of rock rising seventy or eighty feet and crowned with primeval forest; on the left, rising thirty or forty feet, the softer form of the Huronian ridge, rounded by ice action, and showing glacial scratchings wherever the rock is exposed. On the slope of this ridge, a hundred yards or more from the men's camp, stands a tall frame building which is at once recognized as the shaft house. Here is

The vein, shafts,

an engine in fairly good condition yet; the shaft is nearly full of water; and the ore-dump outside has been picked over so often during the last ten years



Map of Moss Township.

that few samples are left worth carrying away. The vein is in the brow of the ridge, and the quartz where exposed at the surface has a width of less than two feet. It appears to run with the formation, but Dr. Bell says it cuts the strata at a small angle. A second shaft was commenced upon it about 100 yards west of the first, but the depth to which it was sunk is not known. A tramway about two hundred yards long connected the shaft-house with the mill, over which the ore was delivered. The mill building

nd mill.

stands under the south bank, a short distance below the junction of the two streams already mentioned. It is a frame structure, in a fair state of preservation, and is equipped with two five-stamp batteries, three Frue vanners and engine and boiler from the works of Fraser and Chalmers. A portable saw-mill is attached, which was driven by the same power, and the piles of lumber standing near by show that it had done a considerable work. The large quantities of chemicals stored in various buildings upon the premises indicate that the company had been arranging to put in a chlorination plant; but why they did not, and why the works were closed down, nobody now living appears to know very certainly. The generally received account is

that it was owing to disagreement between the president of the company, the late James McLaren of Buckingham, and the manager, the late T. A. Keefer of Port Arthur.

History of the enterprise.

The Reports of the Geological Survey are singularly silent on the whole enterprise, almost the only reference to it which they contain being found in a sentence or two written by Dr. Selwyn, which Dr. Coleman quotes[8] In September, 1885, I obtained the facts woven into the following account from Peter McKellar of Fort William, who had been identified closely with the location since the first discovery of gold upon it; and at that time all the steps taken to mine and mill the ore were fresh in his memory:

Peter McKellar's account.

"The vein consists of chloritic and talcose slates in the Huronian formation, and outcrops at several places five to eight feet wide. It was opened out in 1871, and a half interest sold to Messrs. Frue and Sibley of Silver Islet. Some work was done in that and the following year, and a road thirteen miles in length was cut to lake Shebandowan. In 1874 the proprietors organized as the Jackfish Lake Mining Co., and a little work was done on this and other properties. But no substantial work was done until 1881. In that year one and a half tons of ore was taken out and sent to New York for assay by Frue vanners and amalgamation. The test showed $26 of free gold to the ton, and $23 additional in sulphides In that year a company was formed, composed chiefly of Ottawa capitalists. The sum of $50,000 was paid for the property, and $50,000 additional was put in as working capital. Mining was commenced in March of 1882, with Mr. McKellar in charge as superintendent. Buildings were erected and a ten horse-power engine put in, with Blake pump and rock-breaker, ten stamps, four Frue vanners, and two copper amalgamators. Between thirty and forty men were employed up to October, 1884, when work was stopped until August, 1885. It is now (September 20, 1885) in full operation, employing forty men, whose wages range from $30 a month, with board, to teamsters and other laborers, to $35 a month to carpenters and miners. Mr. Eschweiler is in charge as superintendent. A shaft has been sunk to a depth of 130 feet, the richest ore being found at a depth of 100 feet. At a depth of 55 feet one level has been driven upon the vein a length of 150 feet, and one is now commencing 55 feet lower. About 700 tons of ore have been milled and 40 tons of concentrates obtained, averaging $150 per ton, in addition to $1,000 of free gold."[9]

The sample lot sent for treatment to New York appears to have averaged $49 per ton, whereas the 700 tons milled under Mr. McKellar's management yielded an average of only $10 per ton. It is quite likely however that the ore sent to New York was selected, and did not represent a fair average; otherwise, the presumption must be that a large proportion of the gold was lost in the mill run, and this is less likely than the other. At $10 per ton from a vein five to eight feet wide, the property should pay handsomely with the use of modern processes.

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[8] See *ante*, p. 80. [9] Bureau of Industries Report, 1885, p. cxxxviii.

Dr. Bell's account.

The following further account of the Huronian mine is furnished by Dr. Robert Bell in the Report of the Mining Commission, published in 1890 :

" The first discovery of gold in notable quantity was made in 1871 by Mr. Peter McKellar (following up a clue obtained from an Indian) near Jackfish lake, at what is now called the Huronian mine, situated on location H1 in the township of Moss. It here occurs in a true and persistent vein from 6 to 8 feet wide, of which from 2 to 5 feet are quartz, the rest being incorporated schist. The country rock consists of interbedded talcoid, chloritic, dioritic and a little dolomitic schist, siliceous magnetite and massive diorite, all dipping northwest at angles of 65° to 80°. The vein runs northeastward, cutting the strata at a small angle, and underlying to the northwest side at an inclination of 15° from the perpendicular. Intrusive syenite appears about a mile to the northeast of the mine, and this may have had something to do with the enrichment of the vein. The gold occurs free and as sylvanite (or telluride of gold), associated with galena, iron and copper pyrites and blende, which, with the white quartz, constitute a beautiful looking ore. A ten stamp mill was erected in 1883 at great expense, on account of the difficulty of transportation, and in 1884 some mining and milling were done. The gold is understood to have been equal to $21 to the ton, which was however far short of the whole amount contained in the ore. Work was resumed for three or four months in 1885, but from the want of proper means of transportation to the mine operations are for the present suspended. Openings have been made and similar ore obtained from a continuation of the same vein, called the Highland mine."[10]

This account differs in some respects, and notably as to the richness of the ore, from the account given by Mr. McKellar to myself in 1885. Dr. Bell's statement of the gold contents is probably based on the New York test, and not upon the results of the mill run at the mine. But the ore of the Huronian mine is also said to contain silver in promising quantities, which Dr. B. says " was practically overlooked in the efforts to extract the gold."[11]

[10] Mining Commission's Report, p. 25.

[11] Ib. p. 28. It is difficult to reconcile all statements. In a recent letter from Mr. McKellar he says : " In regard to the Huronian mine, I was in charge in 1883 and 1884. I was in charge and mined and milled 700 tons of ore. The bullion (gold and silver) taken off the copper plate was nearly a thousand dollars ; and the concentrates from the 700 tons weighed about 40 tons. Five tons of the concentrates sent to Balbach & Son, Newark, N.J., for reduction, showed a value of about one hundred dollars a ton. The certificate gave : Concentrates 10,525 lb. gross=9,747 lb. net ; copper, 1.56 per cent. ; gold 3.72 oz and silver 27.82 oz. to the ton of 2,000 lb. It should be considered during this operation that for want of development room all that came out of the shaft and drift, rich and poor, had to be put through so as to keep the mill going full time. Half of it was schist that is much lower in grade than the quartz, and should not be put through a small mill like that one. When work was stopped the shaft was down ready for opening the second level both ways, after which the mill could have been supplied easily with selected ore ; but the works had to be closed at a moment's notice to get the men out before the freeze-up. The following year another party was sent in to make a test. They took the concentrators away and undertook to take in a chlorination plant, in which they failed. They also started mining a small branch vein, which I would not think any sane man would work in preference to the main vein that shows so much stronger and richer. Transportation was and is yet too expensive for the mine to pay working ; but with transportation easy, and a large mill to treat the ore, this mine would, I believe, pay well." And again Mr. McKellar writes concerning the operations in 1885 : " I was at the mine once in October, 1885, some little

Dr. Selwyn, who visited the location, says the vein can be traced several hundred yards, and thinks it is four or five feet wide.[12]

We returned by the same route to our camp on Round lake late in the evening, and had a rough experience crossing the lake. Next day at 11 o'clock we reached the camp on lake Shebandowan, through a storm of wind and rain. The total distance from the mouth of Kashabowie river to the Huronian mine is 24 miles, made up as follows in miles and chains :

Returning to lake Shebandowan.

	m.	ch.
On Shebandowan lake, s.w.	8	00
Portage to Mink lake, n.w.	..	50
Mink lake, n.w.	..	10
Portage to Silver lake, w.	..	16
Silver lake, n.w.	..	9
Portage to Duck lake, w.	..	50
Duck lake, w.	..	60
Portage to Round lake, n.w.	..	60
Round lake, w	3	00
Portage to Cross lake, s.w.	1	20
Cross lake, s.w.	..	40
Kawawiagamog river, s.w.	5	00
Grass lake, n.w.	..	20
Portage to Jackfish lake, n.	..	10
Jackfish lake, w.	1	40
Road to Huronian mine, s.w.	1	40
Total	24	25

SOUTH OF LAKE SHEBANDOWAN.

Sunday we rested, and at 6.30 next morning (Aug. 19) we broke camp on lake Shebandowan. Dr. Coleman, Mr. Hammond, myself and three canoemen—Nicol, George and Reddie Patterson—proceeded across the lake for the Mattawin river district, and the other members of the party returned through Kashabowie and Lac des Mille Lacs to Savanne. We had two canoes and a light outfit, as it was known that the route was heavy, and we hoped to be able to complete it in three days. By making an early start it was expected that we could get over the longest water stretches before the wind arose to interfere with comfortable progress, but in this we were not wholly fortunate owing to some delay in finding the first portage.[13]

Planning the next excursion.

time before the close-down. They were stoping and milling the 8 ft. schist bed with the stringer of quartz. They told me the concentrates would go some $60 a ton. There was but little amalgam showing on the plate. They had a few miners working on the main vein in the shaft, driving the second level at the depth of 100 feet. This level was mined along the vein from the shaft some 40 to 60 feet each way when I was there. The vein looked well along the run and in both headings. There was no work going on in the first level nor any stoping. It is true that there was a rupture between Mr. Keefer and the company, for the latter refused to pay the men, or the bills of supplies, or even defend the law suits brought against them. So judgment was given against them in every instance, and the sheriff seized on all the loose property of the company and was going to sell it. When I saw the way things were going I went to Ottawa and explained to the directors how the matter stood—how the loose property would be sold for little or nothing and the debt would still stand against the company. Then they agreed to settle the matter, and sent Mr. R. Blackburn with me to Port Arthur, and he squared up everything. The company did not appear to know anything about the results of the mill work or the yield of the concentrates sold."

[12] Mining Commission's Report, p. 66.

[13] The west wind blows with great regularity on all these lakes from Shebandowan to Lake of the Woods during the summer months, rising usually about nine in the morning and falling about five in the evening.

Loch Earne.

From a small bay on the south side of the lake, about two miles from the mouth of Kashabowie river, a portage a quarter of a mile long leads across into a little blue lake bearing the Scotch name Loch Earne. It is said to be very deep, and better stocked with trout than any other water in the district. By the shore line it appears as if cut off into three distinct bodies of water, with two narrow connecting necks; but in reality it is only one body, without any change of level.

A mining location on the south side of Loch Earne was exploited twenty years ago for gold by cutting a trench through gravel drift for a distance of fifty yards from the shore. There is no appearance of a vein here, and whatever quartz there is has been obtained from float boulders. The property is said to be owned in Fort William, and to be held at $20,000.

Greenwater lake.

We paddled back to the middle section of the lake and made a portage of a quarter of a mile west through burnt timber to the east arm or bay of Greenwater lake. This is the largest expanse of water in the district through which we proceeded south and east of lake Shebandowan. Its waters are beautifully clear, with a shade of green that no doubt suggested the name. On Russell's map the height of land is shown as running between Greenwater and Shebandowan lakes, but the accurate topographical survey made by Hume Proudfoot in 1892 leaves no doubt that the height of land is south of Greenwater, and that the latter discharges by a small river into lake Shebandowan.

Our course was west about a mile and a half, and then south between a large island[14] and the mainland through a narrow and picturesque channel into the main body of the lake. The lake opens to the west and south five or six miles, and by the time we entered this portion of it the west wind had risen and there was a lively show of whitecaps on the course before us. Running in the trough of the sea, the waves often broke over the low gunwale of the canoes, but we got through without anything more serious than a little wetting, and turning a point of land on the east shore we entered a narrow bay and up a sluggish stream to the inevitable portage.

An extensive body of iron ore.

It was after ten o'clock when we got out of Greenwater lake, and Mr. Hammond advised that this was a good spot for dinner. Accordingly Nicol, George and Red began the culinary duties, while Mr. Hammond suggested that the doctor and myself should take a stroll with him into the woods. We proceeded along the base of an escarpment of rock which rises perpendicularly about thirty feet, and at the first easy point made the ascent of it. The rock is a dark hornblende, not particularly interesting; but presto! there was a change; the doctor's hammer came down and broke off a lump of iron ore. Mr. Hammond had planned to give us a surprise in his modest way, and he had several others in store as we discovered before the trip on which we had entered was finished. We came to learn indeed that he is a very modest man for a mining prospector, and that unlike many of his class he exaggerates nothing. We measured the ore body and found it to be 48 feet wide, but the length was not ascertained; Mr. Hammond informed

[14] Called Rocky island on Proudfoot's map. The outlet of the lake is half a mile northwest of this island.

us that it is at least a quarter of a mile. On the face of the bluff the ore shows down to the base; how much deeper it is can only be ascertained when it is worked. Hornblende forms the wall upon the east side, and a band of diorite about 25 feet wide the wall on the west, beyond which hornblende schist comes in again, but some ore is interbedded with the schist. Mr. Hammond discovered this deposit in 1892 and five locations (R526-530) have been surveyed, with an aggregate area of 1,000 acres; the patents however have not yet been taken out. The ore is magnetic, and analyses are said to have given 51 to 53 per cent. metallic iron.

Greenwater lake to Mattawin river.

The creek upon which we had entered is the outlet of a series of small lakes and marshy ponds extending eastward about six miles, the course of which in low water steadily increases in difficulty as the ascent is made. At an early stage we were obliged except in the larger lakes either to drag the canoes through the shallow water, sinking to the knees in mire, or to make portages in dense woods where a trail was hardly visible; and this continued until the height of land beyond Boulder lake was reached. Thence to the foot of Copper lake, where we camped for the night, the route was easier. Following is the day's itinerary as furnished by Mr. Hammond:

The day's itinerary.

	m.	ch.
Shebandowan lake, s.e.	2	00
Portage to Loch Earne, s.	0	20
Loch Earne, s.e.	1	40
Portage to Greenwater lake, w.	0	20
Greenwater lake, w. and s.	5	00
Creek to portage, e.	0	10
Portage around rapid, e.	0	3
Creek to decharge, n.	0	20
Decharge to marshy lake, e.	0	15
Marshy lake to portage, n.e.	0	20
Portage to marshy pond, e.	0	9
Marshy pond to portage. e.	0	12
Portage around low water in creek, s.e.	0	40
Creek to Long Point lake, e.	0	40
Long Point lake, e.	1	40
Portage to small lake, e.	0	16
Small lake to creek, e.	0	5
Creek to portage, e.	0	10
Portage to small lake, e.	0	6
Small lake to portage, s.	0	10
Portage to beaver pond, e.	0	4
Beaver pond to creek, e.	0	40
Creek to portage, n.e.	0	10
Portage to small lake, n.e.	0	22
Small lake, e.	0	40
Portage to Boulder lake, s.e.	0	5
Boulder lake to portage, e.	0	30
Height of land portage, s.e.	0	33
Miry lake to portage, e.	0	50
Portage to Copper lake, e.	0	13
Copper lake, s.e.	2	40
Total	19	13

This distance is composed of thirteen lakes and ponds, 14 miles 7 chains; four sections of creek, 1 mile 40 chains; and thirteen portages (including one decharge), 2 miles 46 chains.

Eight small lakes and ponds, the last and highest of which is Boulder lake, are drained by the creek we ascended from Greenwater lake; while the waters from Miry lake eastward are conveyed through a creek of unknown name that we descended into the Mattawin river.

The land and the timber.

As far as could be seen there is no good land in the region through which we passed, and no valuable timber. Spruce is plentiful in some places, but does not attain to large size, and there is one small area of pine near the height of land; the ground is covered with green moss, and along some of the portages the undergrowth is dense. Some shows of iron ore are said to occur to the south of Boulder lake, but we did not visit them.

IN THE MATTAWIN VALLEY.

Copper lake.

Copper lake, the second body of water along the chain east of the height of land, has a length of two and a half miles, and at the eastern end is narrowed along the line of contact between granite and Huronian schist. At the outlet it is rock-rimmed, the water flowing through a channel two feet wide, a foot deep and three feet long, to fall about twelve feet into a narrow gorge that has been cut back through a ridge of very hard banded slate not more than a hundred feet wide. One might suppose that a very few years would suffice to complete the cutting back into the lake, the result of which would be to lower its level ten or twelve feet; only one does not know how long it has taken the water to wear the gorge back to its present station—possibly as long as it has taken the Niagara river.

It rained at intervals through the night, but Tuesday morning was clear and cool. We were astir at 5.30 and left camp at 7, taking a due south course over a portage of three-quarters of a mile to Keek-keek or Hawk lake.

In the track of a wind storm.

The trail could not be followed for more than half the way, as all the timber had been blown down by a wind storm which swept across the country two or three years ago. Mr. Hammond told us that two of his men narrowly escaped being caught in this storm. They were close to the portage at the time, and such was the wreckage of fallen trees in the wake of the gale that it took them more than half a day to cross from Keek-keek to Copper lake. Its course was from west to east, keeping along the north side of Keek-keek lake, and we observed its track for a distance of several miles. Only the hills and higher ground appeared to have felt the force of the blow; the intervening low lands were passed over unharmed. It would seem also that the wind was not cyclonic, for the whitened trunks of the trees lay parallel with each other on the hillsides, like sheaves of wheat on a harvest field, and not in every possible direction as occurs in a real cyclone.

Keek-keek lake to

The canoes were put into the water again where the portage trail comes to the creek flowing down from Copper lake, about 450 yards from its mouth. The channel has a tortuous course through a border of willows and coarse grasses, but finally opens into a round sheet of water with a high and

bold shore of rock on the south side. This is the upper section of Keek-keek lake, and passing southeastward through a gap the main body of the lake is seen to extend to east and west a length of five or six miles, with a breadth of one to one and a half miles. Several pairs of hawks were observed circling high up in the air over the lake, and three or four nests were seen in the tree tops along the southern shore, which no doubt accounts for the origin of the name of the lake.

From Keek-keek lake the stream broadens to river dimensions, with rushes and wild rice along the greater part of the way to its mouth in Mattawin river, and there are stretches of excellent canoeing. At the foot of Blossom lake is a band of granite, over which the river tumbles in a pretty mass. The volume of water is not large, and three miles below the falls it contracts to a narrow rushing stream, strewn with ugly boulders. A short portage around the base of a high ridge of rock leads to another stretch of level and deep water, and in a swampy valley covered with willows, grasses and rushes, we floated into the Mattawin almost without perceiving it. The Mattawin river.

THE QUARTZITE GOLD LOCATIONS.

Half a mile below the junction we landed and had dinner; and thence half a mile farther we reached the mouth of Gold creek, which flows down from the north. The valley of the Mattawin is here quite wide, but it is low and marshy. We turned up Gold creek, a sluggish stream about twelve yards wide, with borders of willow on either side. The channel is three or four feet deep, and there is good canoeing through low country for three miles. Then come rocky shores, with high ranges inland, and shallows over which the canoes were pushed another mile to a small island below the first falls, where we landed and pitched our tents. The river divides into two streams at the falls, and descends over rock sloping at an angle of 45°, the effect of which must be fine when the water is high. Tracks of moose were seen frequently in coming up the stream, and the water lily was closely cropped all along the banks. Bear tracks were also observed crossing the creek at several points. Up Gold creek.

There is a miners' camp or shanty at the falls, on the west side of the creek, and a small clearing has been made around it. This is location AL 61 of what is known as the Quartzite gold mines. Several paths or trails were found leading from the camp westward and northward, all of which we followed—to the west half a mile, and to the north along the creek a mile. Four prospecting pits have been opened in the bluffs along the river towards the north, in the county rock, which contains iron pyrites in minute particles. There is certainly a great body of rock, and the owners claim to have got assays showing $2 to $7 of gold per ton. The two largest pits are on the west side of the creek, about half a mile north of the camp, but the extent of the workings is too limited for a safe opinion to be formed of the value of the property. The Quartzite gold locations.

The itinerary.

Following is a record of the day's march, as supplied by Mr. Hammond:

	m.	ch.
Portage from Copper lake, s	..	60
Creek to Keek-keek lake, s.e	..	20
Keek-keek lake, e	3	00
River to Blossom lake, s.e	5	00
Blossom lake, e	1	00
Portage around falls, e	..	3
River to portage, s.e	3	00
Portage around rapids, s.e	..	24
River to portage, s.e	..	20
Portage around rapids, s.e	.	3
River to Mattawin junction, s.e	..	60
Mattawin river to Gold creek, e	1	00
Gold creek to "Quartzite mine," n	4	00
	—	—
Total	19	30

THE MATTAWIN IRON RANGE.

A walk across country.

Tuesday night was uncomfortably cold, and upon rising early Wednesday morning we found that ice had formed on a basin of water alongside the tent. The two Indians were sent down stream with the canoes, and were instructed to meet us at the foot of the second falls on the Mattawin river, where that stream is crossed by the Mattawin iron range. The other members of the party left camp at 6.25 a.m., going eastward on a well-cut and easily travelled road through a forest of jack-pine; for the greater part of the way a region of sand and gravel too poor and dry for the nourishment of thrifty trees, with natural glades at intervals, and rarely a stream of living water.

Hill No. 8.

At the end of a steady walk of nearly three hours we reached location W222, known as Hill No. 8 of the Mattawin iron range, owned by the Mattawin Iron and Mining Co. A trail a quarter of a mile long leads from the road to the top of the hill, rising gradually to a hundred feet above the plain, and following it we came to the outcropping of ore. From this height a commanding view is obtained of the country towards the south and southeast; and among the prominent objects visible is the Mesabi iron range, fifteen miles or more away, which is supposed to extend from Minnesota into Ontario as far as the head of Thunder bay. Eastward is a succession of high hills, some of which we crossed later in the day, the nearest being a mile distant and rising considerably higher than the ridge on which we stood. The ore of No. 8 hill is hematite, of banded structure, and mixed with some jasper on the west side. On the east side are two terraces of ore with perpendicular faces at one point, each of which is about thirty feet in height. We measured a cross-cutting near the northern end of the ore lens and found it to be 400 feet; another cross-cutting farther south is said to be 480 feet, and the length of the ridge is about half a mile. Two pits have been sunk upon the summit to a depth of ten feet, showing clean ore, and analyses are said to give 55 per cent. of metallic iron. From the east side this hill of ore might be worked as an open quarry for half its length.

We were told by Mr. Hammond that he had explored several other large shows of iron ore on the same range farther west, but for lack of time we did not visit them.

Hill No. 7 is on location W221, a mile east of No. 8, and rises 180 feet above the plain as measured by an aneroid barometer. Jasper is more conspicuous than in No. 8 upon the west side of the hill, and the ore is leaner, but on the east side it is of good quality. The ore lens is 485 feet wide, and Mr. Hammond says the length is fifteen chains. Borings were carried on here with a diamond drill about three years ago, the records of which have been furnished me by Mr. W. W. Roche, who had charge of the drill. Hill No. 7. Exploratory work with a diamond drill.

First boring on northeast side of hill, at an angle of 45° north :

	feet.
Ore and rock mixed	48
Ore	12
Black rock	5
Ore	5
Black rock	20
Ore	55
Jasper	1
Ore	5
Jasper and black rock	15
Ore	6
Jasper and black rock	11
Ore and rock mixed	2
Ore and slate mixed	39
Diorite	36
Total	260

Second boring on top of hill, at an angle of 60° south :

	feet.
Ore and rock mixed	88
Ore and jasper mixed	4
Jasper	1
Ore and rock mixed	101
Black ore	1
Red ore	26
Rock	1
Black and red ore mixed	10
Rock	1
Black and red ore mixed	10
Rock	12
Ore	1
Rock	2
Ore	22
Total	280

Mr. Roche says of the second prospect that it "showed very rich ore, which was struck at 194 feet and continued good with some small bands of rock between until the hole was finished at a depth of 280 feet. As the drill we had would only bore to a depth of 300 feet, it was impossible to determine the extent in width or depth to which the ore would run."

Leaving No. 7 Hill we descended by a road towards Mattawin river, passing No. 6 on our right. The river was reached at the second falls, where

Hill No. 5.

the Indians were awaiting us with the canoes, and crossing over we ascended Hill No. 5, on locations 218W and 219W. Here there is a high outcropping of slaty ore fifty feet wide and a quarter of a mile long, with jasper on the west or foot wall similar to No. 7. The strike of the ore body is east and west, and the dip 85° north.

Falls of the Mattawin.

The first and second falls are on location 219W, and the third is about half a mile below the second. Each of the three falls has a height of about twenty-five feet, and they would doubtless supply ample power to generate electricity for driving mining machinery and operating a very considerable length of railway besides.

Junction of Shebandowan and Mattawin rivers.

We descended the Mattawin from Hill No. 5 half a mile to the third falls, on the south side of which is a portage of about 300 yards. A barrier of stones in the channel below these falls makes canoeing unsafe in low water, and perhaps even at flood-time, and landing upon the left bank we portaged along the road built out to the mining locations, through a fine forest of poplars a mile and a quarter to the mouth of the Shebandowan river. This is the outlet of Shebandowan and its tributary lakes, and its clear blue waters rush down with great force to join the brown waters of the Mattawin. The two rivers are of nearly equal volume; yet the numerous sand bars and buttresses of stone make the task of running and guiding canoes more hazardous below than above their junction. Both banks are well timbered with poplar, spruce, balsam, jackpine, etc., for the next three miles, or as far as Hill No. 1 (location 211W) of the Mattawin Iron and Mining Company. Here we landed on the south bank, and found lodgings for the night at a shanty built for the housing of the company's miners in the winter of 1893.

Hill No. 1.

Hill No. 1 is half a mile southwest of the miners' camp. The ridge is a quarter of a mile long and the outcropping of ore 50 feet wide. At the surface, where some work has been done, it presents a beautiful exhibit of jasper breccia, with some iron ore and chert intermixed. In the first five months of 1893 development operations were carried on upon the property, and besides pits and cross-cuttings a shaft of 56 feet was sunk, 8 by 10 feet inside the timbers. Mr. Hammond informed us that the jasper was disappearing and the ore growing richer as work upon the shaft proceeded, but the company was not disposed to expend more money on the work at that time.

Extent of the Mattawin iron range.

The Mattawin Iron and Mining Company has had surveys made of nineteen locations on the Mattawin range, from 211W to 229W inclusive, the whole distance from east to west being seven miles and the aggregate area 4,480 acres; but it has taken out the patents for only seven locations, having an area of 1,600 acres. Mr. Hammond has taken up for himself locations 152E and 153E east of No. 1 Hill; and he has traced and prospected the iron range from the last named location due west to Greenwater lake, and thence southwest to Hunter's island, and reports shows of ore at frequent intervals over its entire length. His belief is that the Mattawin range in its course eastward joins the Mesabi, probably at some point east of the Kaministiquia river. It is also probable that in its southern extension to and across Hunter's island it connects with the Vermilion iron range in Minnesota.

POSSIBILITIES OF AN ELECTRIC RAILWAY.

Reference has already been made to the utilization of the Mattawin falls as the source of power for working mines and railways. The projectors of the Ontario and Rainy River Railway had in view two or three years ago the construction of that road from a point at Sand lake on the line of the Port Arthur, Duluth and Western Railway northwest to the iron ore deposits on the Atik-okan river; but since the more careful exploiting of the Mattawin range they are disposed now to start at a point nearer Fort William, probably at the crossing of the Kaministiquia river, locate the line west along the Mattawin iron range to Greenwater lake, thence through Moss township in an almost direct line to the Atik-okan range, and thence down the valleys of the Atik-okan and Seine rivers to Rainy lake and the fertile lands of Rainy river. It is reported that a route favorable for railway construction is obtainable for the eastern section along the course here indicated; and besides the likelihood of securing the carrying trade of the mines, which is a consideration of first rate importance, there is the possibility of operating the line as an electric railway with power derived from Kakabeka falls on the Kaministiquia, the three falls on the Mattawin, and a succession of falls and rapids on the Atik-okan and Seine, besides other intervening streams; and if there are sections in which water power is lacking, stationery steam engines could be established for generating electric energy, using cheap steam coal for the purpose. In a country so well supplied with water power as this region of Ontario, it appears to be almost certain that an electric railway can be constructed and operated at considerably less cost than a steam railway. The chief objection to an electric railway heretofore has been the loss of power or energy by transmission, but it is claimed that with the latest improvements power may be transmitted 25 miles at a loss no greater than 25 per cent. With the steam engine, Maxim points out in a recent magazine article, it is necessary to propel over the line a very heavy locomotive and a large supply of coal and water. In the electrical locomotive the engine can be much lighter, and of course the coal and water can be wholly dispensed with Therefore he says we can have in the electrical locomotive cheaper power and a very much lighter train to propel, while the reduction in weight will also greatly reduce the wear and tear of the line. Electricity could be employed on any existing road, but where special roads are constructed a comparatively cheap line will serve the purpose, "and as the electric train would be vastly lighter than the steam train, expensive grading and tunnelling would not be necessary. The line might follow approximately the contour of the country. In the steam-driven train," this distinguished inventor proceeds to say, "great power is required to enable it to mount even a slight gradient, and all this energy is wasted in heat and friction on the brakes in descending the next grade. The extra amount of energy consumed by an electrically driven train in mounting a gradient could again be utilized in descending the next gradient, because the descending train, moving at a high velocity, instead of having its speed checked by the use of brakes, could turn a switch in such a direction as to convert the motors themselves into generators which would actually send a

Ontario and Rainy River Railway.

Advantages of electric power to operate the line.

current into the line which would be available for the use of other trains. The storing of energy developed by a descending train has always been a desideratum ; it is quite impracticable to use it with our steam-driven trains, while it is a simple matter in trains driven by a cable or by electricity." [15] There would of course be difficulties in the way of keeping a railway open in this northern country during the long winter, but they are not likely to be insurmountable, and the electrically-driven railway has advantages which the steam-driven railway does not possess.

BACK TO SAVANNE.

Thunder storm on the Mattawin.

An ominous thunderstorm came up in the evening, during our visit to No. 1 Hill, and heavy rains fell at intervals during the night and early morning ; but the accounts afterwards given by the members of our party on Lac des Mille Lacs showed that it was wilder and of far greater violence there.

By river,

Thursday morning the sky cleared off at 7.30, and the day was fine and warm. At 9 30 we left the camp and proceeded down the river three miles in a straight line, or nearly five miles by the water, to Brown's lane. There are several rapids where the channel is either filled with boulders or partly dammed over with gravel, on two or three of which our canoes grounded. At one place about a mile above the lane we noticed an outcropping of chert along the south bank, from which samples were taken. On the north side, near the same place, is a bank of clay and sand about twenty feet high, showing distinct lines of bedding.

Brown's lane and the Dawson road to Finmark.

At 10.30 we landed and walked three miles northeast to Finmark station, packing the canoes and camping outfit, and arrived there at 12. A long mile on the lane brought us to the Dawson road, close to one of the station houses of that one-time famous highway. It was here that the Wolseley expedition of 1870 diverted from the unfinished road, going south to the Mattawin and up that river and the Shebandowan to the foot of Shebandowan lake. A short mile east on the road, and a mile northeast across ranges of high hills brought us to the station, where a few minutes later Mr. Hammond and his Indian took an east-bound freight train for Fort William ; while the rest of us boarded a colonist train carrying 400 or more laborers for the Manitoba harvest fields, and reached Savanne at 14 o'clock. The remainder of the day was occupied in getting ready for next day's journeys—Dr. Coleman for the east and home, and myself with Mr. Cameron and my son for the canoe trip down the Seine waters to Fort Frances.

Chief Peter and his band again.

The Indians from Poplar point had come in to do their shopping, and four or five wigwams were pitched near our camp. Chief Peter arrived with his younger squaw later in the day, and as patriarch of the gens he sat in state in his canoe while his wife paddled up the river. His clothes did not quite become a chief, being tattered and of many colors ; but retiring behind the bushes in a potato patch he soon reappeared with a whole suit, and on his breast a Treaty medal bearing the date of 1874. Walking up to the door of the tent where our Indians were having supper, he stood and stared rigid,

[15] Hiram S. Maxim in Cassier's Magazine for January, 1896, pp. 253-4.

like a setter when he gets scent of birds, until they handed out a plate of food and pannikin of tea, when he sat down upon his haunches and ate with great relish, using his fork like a man of society. The ten or twelve dogs which formed a necessary part of the Indian quarters seemed to haunt our tent doors all night, and next morning a few bones thrown towards one of the wigwams engaged them in a mad riot. One mangy fellow, at which every dog and Indian had a grudge, was the first to be set upon; then the fight became very mixed, like a knock down and drag out set-to in a bar room, in which each cur, like the Gow Chrom, fought for his own hand; but under the heavy and well-directed blows of an angry squaw they dispersed, and for the rest of the morning we had peace and order.

A dog riot.

Savanne to Mine Centre, on Shoal Lake.

At 10.40 Friday morning we broke camp at Savanne. Dr. Coleman went east by train, while I took over his canoes and Indians (Alec and Nicol Mainville) and started for Fort Frances. Ordinarily it is a seven days' journey; but much depends on wind and weather, and accordingly we laid in a ten days' supply of provisions. The water was favorable, but with a mild wind blowing from the south, and at 11.40 we reached Sand point. At 1.15 p.m. we set off again, to discover that in the interval for dinner the wind had risen and that the waves were troublesome beyond the point. Calling at Poplar point to get a possible supply of fish, we were lucky enough to get some moose steak instead, an Indian hunter having killed one of these noble animals the day before. We continued in a southwesterly and westerly course in the lee of successive islands, but the wind rose steadily and on the longer traverses the canoes shipped considerable water. At 5 o'clock we reached Long point and camped for the night. This archaean promontory extends from the north about two-thirds of the way across the lake, and a fine sand beach at its southern extremity makes it a favorite camping ground.

Supplies for the trip.

Poplar point to Long point.

Saturday morning our camp was astir at 5 o'clock. It was warm, but cloudy, with a smart wind blowing. The sand beach suggests that this is a good spot for bathing, although the brown water does not tempt one, and the brown leech with which it abounds terrifies one.

At 7 the wind fell and a quarter of an hour later we paddled off for the southwest. There was however only a temporary lull in the wind, which rose presently as we entered the wide traverse beyond the promontory. Far away towards the northwest the waters of Lac des Mille Lacs flow out through Seine river, but our course lay near the southern shore, where there are numerous islands and deep bays. Wolseley, who crossed this lake at the head of the Red River Expedition in 1870, describes it as "a curiously shaped and straggling expanse of water, in which there are islands without number, many being of sufficient size to have great bays stretching for miles into them. One island so closely resembles another," he says, "that it is wonderful how any of us found our way over the 20 miles to be travelled before we reached the next portage. Even the brigade, furnished with the most experienced guides, strayed sometimes for hours out of their course. Steering solely by the compass took one repeatedly into these large bays;

Long point to Baril bay.

and nothing is more disheartening than finding one's self in a cul de sac after a pull for many miles up one of these bays, and having to row back again to search for another passage."[16] I was more fortunate, for although the Indians Alec and Nicol had only been over the course one time before, on the way up with Dr. Coleman, they never faltered or wavered, but paddled straight on as if guided by the instinct of a homing pigeon.

At 9.50 we reached the end of the lake, and through a narrow passage entered Baril bay. On the south side is a new lumber camp, on the edge of a pine forest, a portion of which has been destroyed by fire. Eastward on the same shore the country had evidently been overrun by fire many years ago, and is now sparsely covered with poplar.

THE NAMAKAN RIVER WATERS.

Across the height of land into Baril lake.

Baril bay has three expansions, the last one bending south a mile and a half to a portage at its head. This portage is about a quarter of a mile long, and is on the Dawson route. It crosses a height of land, and Baril lake at the southern end of it belongs to the system of waters drained southwest through the Maligne and Namakan rivers into the southeast arm of Rainy lake.[17]

The shores at the east end of Baril lake have been burnt over, but are now covered with copse. For nearly two miles it lies east and west; then it bends northwestward and its banks contract to a width of 300 yards, and are finely wooded. Again it lies east and west, widening to half a mile or more and presents fine shore lines covered to the water's edge with a dense growth of small timber. At the western end there is a traverse of a mile and a half long and wide, and a high rocky promontory of gneissic rocks extends eastward into it nearly half a mile. Within 300 yards of the lower end the lake contracts to 50 yards or less, bending southward to the decayed dock of the Dawson route at the head of the portage. Formerly the lake had two outlets with a high bluff of rock between, but the lowering of the lake has left the western channel dry and the outflow is now wholly through the eastern channel

Brulé portage,

The portage to Brulé lake is about half a mile long, but when the water is high canoes may be put into the creek at a point half way across. On the Brulé side the road slopes down a gravelly hill, and is in very good condition yet, the descent from one lake to the other being about 50 feet.[18]

[16] Travel, Adventure and Sport from Blackwood's Magazine, No. II, p. 277.

[17] Baril bay belongs to the Seine river system and has no connection with Baril lake. The French name is by some writers exchanged for its English equivalent, Barrel, while one traveller calls it Keg and another Bar. The waters of the lake are clear and blue, while those of the bay are brown.

[18] The following distances and levels are given in Hind's Red River Expedition, vol. II., Appendix I:

	m.	ch.	Feet above lake Superior.
Thousand Lakes to Baril portage	21	60	832.68
Baril portage		17	834.54
Baril lake	8	00	834.54
Brulé portage		21	787.52
Upper Brulé or Cannibal's lake	8	00	786.02

Brulé lake is only about a mile long and half a mile wide, and obviously it has received its name from the fire which destroyed the timber on its high banks many years ago. The second growth had attained to goodly dimensions, but it too was swept by the great fire of 1894. On the north side the banks rise to a height of a hundred feet or more, which towards the western end of the lake descend in terraces to the shore line. The profusion of purple flowers which covered these slopes presented a very pleasing effect in contrast with the blackened forest upon the opposite side of the lake. The outlet is a stream 25 to 30 feet wide, flowing swiftly towards the west and northwest in a meandering channel ; therefore clearly showing that Brulé is a distinct lake, and not a part of Windegoostigwan lake as shown on some maps and described by Hind and others. and Brulé lake.

The upper reach of Windigoostigwan lake for a mile or more is about 200 yards wide. The wind was blowing a smart breeze as we entered the wider portion, which lies east and west, and instead of camping on the north shore as we had intended we were obliged to turn towards the nearer east end, with its fine eliptical shore line and smooth wide sand beach, and pitch our tents in the edge of the thick wood there for over Sunday. Walking along the beach I saw fresh tracks on the sand which I supposed to be a dog's, but could not comprehend how a dog came to be there. "It's a link," Nicol said ; and that night the tent door was closed with a little more care than usual. "It is now 8 o'clock," my note book reads, "the wind has died away, the waters have quieted down, the sky is clear, the new moon is hanging over the lake, the air is pleasantly cool, and our camp fire is blazing on the beach." Yet it is hard to repress a sense of loneliness at the thought that here one is as much cut off from the haunts of men as if he was in the middle of the Atlantic. Windigoostigwan lake.

Sunday morning broke with a thunder storm, which did not clear off until 8 o'clock. The lake was delightful for bathing, clear, and cool enough to be invigorating, the bottom of white sand sloping gently off into deep water. What a pretty summer resort this might be, were it not so far away ! But there are hundreds just as good in our Northern Ontario, much nearer at hand, and a hundred years hence they may all be in requisition by people who must have summer homes and the rest and quiet which the forest affords. Resting in camp

High terraces of gray gneiss rock on the north side of the lake, covered with poplar and Norway pine which the fire had partially destroyed the year before, invited one for a stroll when there was nothing else to be done, or no better way of passing the time. There are three long rough steps which rise to a height of nearly 200 feet above the lake, and as very little soil exists on the rocks the trees have small hold on the ground and many have already fallen since the fire. We walked eastward about 200 yards on the highest terrace and descended into a ravine thickly covered with bushes and small timber, where the moss and peat were saturated with water trickling down the rocky slopes on either side. Crossing a ridge towards the south Mr. Cameron and myself entered the valley of a spring creek which empties into the lake near our camp, and where some brownish colored animal was startled out of its lair in the trunk of a fallen tree and quickly disappeared in the

close timber. It may have been the lynx, or it may have been only a rabbit; there was no chance to see which, with the glimpse to be had of it.

In the afternoon the wind blew strong out of the west, raising quite a swell on the lake and foreboding, the Indians said, rough weather for the morrow. But Indians are not prescient above all others even in affairs of weather, in which they are commonly supposed to be very wise, and in this instance the sequel proved that they were not weather prophets.

"The devil that eats you."

I asked Nicol what the name of our lake meant, for besides knowing his mother tongue Nicol prided himself upon having gone to the mission school. Pointing to a gray island rising high out of the lake, he said, "Windigo—great giant, the devil that eats you." Asked as to the rest of the word, he replied, "Stigwan—I donno; something, I guess so." Mr. Aubrey White, the Assistant Commissioner of Crown Lands, who has a good knowledge of the Ojibway or Chippewa language, was able to tell me offhand that the name is compounded from Windigo "great giant" and Oshtigwan, "his head.'[19] The origin of the name is probably to be found in the weird story told by Keating, one of a party of United States explorers who made the ascent of those waters from lake Winnipeg to lake Superior in 1823. "A more gloomy name is that of Cannibal or Wandigo lake, which is derived from the unnatural deed which was perpetrated in its vicinity. It is said that a party of Indians belonging to Oschekkamega Wenenewak or band of the cross ridge were once encamped near this lake in the year 1811 and were quite destitute of provisions; they amounted to about forty; their numbers gradually diminished through famine, the survivors feeding upon the bodies of their deceased relatives; finally there remained but one woman, who had subsisted upon the corpses of her own husband and children, whom she had killed for this purpose. She was afterwards met by another party of Indians, who, sharing in the common belief that those who have once fed upon this flesh always hunger for it, put an end to her existence. The Oschekkamega band, inhabiting a very barren country are often reduced to cannibalism from necessity, and the frequent recurrence of it has almost deprived them of the abhorrence which men naturally feel for anthropophagy. It was not therefore from horror, but rather from a feeling of self preservation, that the woman's life was taken away."[20]

A weird story of the lake.

[19] This too is the meaning according to Baraga. Windigo—fabulous giant that lives on human flesh; a man that eats human flesh; cannibal. Oshtigwan—his head. Windigokwe—fabulous giantess living on human flesh.

[20] Wm. H. Keating's Narrative of an Expedition to the Source of the St. Peter's River in 1823, vol. II, p. 128. And Wolseley in his Narrative tells a somewhat similar story. "We were once pointed out an old woman who some years ago had supported life, when in a starving condition, by eating human flesh—by no means an extraordinary or unusual occurrence amongst those people when in such straits. She was certainly a most loathsome creature to look at; her face was so deeply wrinkled, and the wrinkles so full of dirt, that she seemed as if tattoed." Narrative of the Red River Expedition in series of Travel, Adventure and Sport, No. II, p. 279. A horrible story of a man-eater is also told by Alexander Henry in his book of Travels and Adventures in Canada, pp. 206-10. The incident occurred at Oak bay on the north side of lake Superior, twelve leagues from the Sault, in the winter of 1767. A young Indian came into Henry's camp in a starving condition. "The appearance of this youth was frightful; and from his squalid figure there issued a stench which none of us could support." His crime was suspected, search showed where he had killed and eaten a victim, and he confessed to the killing and eating of four others, with the help of his last victim." "The Indians entertain an opinion," Henry writes, "that the man who

Monday, the 26th, we were up at 5 o'clock and found it a beautiful clear morning, with the lake still, and the barometer rising. At 7.15 the canoes were loaded and we left again for the west. The lake is bounded north and south with high rocks of gray gneiss, and in the centre is a large island of the same material, the great giant's head, which divides the Dawson route to the southeast bay of Rainy lake from the route down the Atik-okan and Seine to the northeast or Seine bay of the same lake. The timber on the island and the north mainland has been burnt over, and the naked gray rocks on shore are exposed at every turn. The lake here is less than a quarter of a mile wide, and the bold shore lines so near at either hand, with occasional clumps of green pine, make the scene a picturesque one. The boundary line between Thunder Bay and Rainy River districts is crossed near the western end of the lake. Paddling up into a small V-shaped inlet we landed beside a heap of Laurentian boulders and packed two trips northward across an ugly portage to a little lake, and thence across another half mile portage to Elbow lake. The general impression is that the outlet of Windigoostigwan lake is by way of the Dawson route and down French river into Pickerel lake; but I noticed that it also has an outlet from the head of the V-shaped inlet northward, gurgling through the mass of boulders to reach a swampy hollow on the left, and on to meet another small stream which flows west about midway across the portage, doubtless to descend with the waters of Elbow and several other small lakes in that vicinity to rejoin those of lake Windigoostigwan in French river. Two ridges each forty or fifty feet high have to be surmounted on this portage, and for the rest of the way the trail is either through a half grown thicket of bushes or across bog and water. The descent at the farther end is precipitous, and leads to a small lake lying in an east and west depression about a hundred yards wide. The portage thence to Elbow lake had probably been visited some time by a wind storm, as the fire of 1894 had licked up every stick of timber left upon it, leaving the thin gravelly soil brown and naked, but plentifully strewn with massive gray boulders of gneiss and outcroppings of the same rock in place which gave to the scene the appearance of an ancient and desolate graveyard. It was 9.40 when we reached the head of this portage, and at 10.35 we set off to cross Elbow lake.

Resuming the journey westward.

Out of Thunder Bay and into Rainy River district.

The double portage to Elbow lake.

Elbow lake derives its name doubtless from its shape. It is a fine sheet of clear water, with shores and islands of grey gneiss brought into conspicuous relief by the sweep of the fire; hardly a green tree is to be seen in any

Elbow lake.

has once made human flesh his food will never afterward be satisfied with any other. It is probable that we saw things in some measure through the medium of our prejudices; but I confess that this distressing object appeared to verify the doctrine. He ate with relish nothing that was given him; but, indifferent to the food prepared, fixed his eyes continually on the children which were in the Indian lodge, and frequently exclaimed, 'How fat they are!' It was perhaps not unnatural, that after long acquaintance with no human form but such as was gaunt and pale from want of food, a man's eyes should be almost riveted upon any thing where misery had not made such inroads, and still more upon the bloom and plumpness of childhood; and the exclamation might be most innocent, and might proceed from an involuntary and unconquerable sentiment of admiration. Be this as it may, his behavior was considered, and not less naturally, as marked with the most alarming symptoms; and the Indians, apprehensive that he would prey upon their children, resolved on putting him to death. They did this the next day, with a single stroke of an axe, aimed at his head from behind, and of the approach of which he had not the smallest intimation."

direction around it or upon it. In the last mile and a half towards the we
end the lake narrows to about 250 yards, with steep wooded banks north a
south, but which of course were fire swept. We arrived at the portage
the north side, near the west end, at 11.25.

BACK INTO THE SEINE RIVER SYSTEM OF WATERS.

Across the divide.

The portage ascends naked Huronian rocks 60 or 70 feet, crosses a tab
land about a quarter of a mile and descends 40 or 50 feet to a lake half
mile wide[21]; whence is a portage of 75 yards across the height of land
Crooked Pine lake, once more in the Seine river system.

We paddled off from this height of land portage upon Crooked Pine la
at 12.25 p.m. Rain had been threatening for the past two hours, a
thunder storms had been passing west and north of us. It was now getti
very near, and we made haste to reach a camping ground on a narrow poi
which runs far out into the lake, a mile or more from the last portage. W
reached it at 12.40 and got under cover of the tents just as the storm brok
Last year's fire swept over this pretty point, which at the portage is not mo
than a hundred yards wide, and only a few Norway pines are left standing.

Crooked Pine lake.

The rain ceased at 3 o'clock, and we started off at 3.25 with the wi
behind us. Crooked Pine lake, a body of clear blue water, has a total leng
from east to west of about ten miles, and the breadth varies from half a m
to a mile, but narrowing at two places where points of land project from t
opposite shores to not more than a hundred yards. From the portage to t
western or lower end the distance is about eight miles, and for the first h
of the way the timber on both sides has been destroyed by fire. The wi
rose as we proceeded, and the waves bore our canoes along at a goodly ra
The north shore runs due east and west, with the rocky bank rising stee
25 or 30 feet in the last two or three miles and covered with small spru
poplar, etc., to the water's edge. Beyond the last point coming in from t
south the waters are shallow and grown with tall rushes, excepting a narr
open channel along the northern shore. Several mining locations have b
surveyed here, extending up to Partridge lake. The lake near its west
end contracts to a hundred yards or less, beyond which are bays opening
to north and south with low bushy shores.

Atik-okan river.

The outlet of Crooked Pine lake is the Atik-okan river[22], and we ente
its channel at 5 o'clock under the shadow of wide-branching trees. It
shallow and narrow, not more than thirty yards wide where it flows ou
the lake, and scarcely deserving the name of river. A few minutes' paddl
gave us the first of many experiences on this stream—an obstruction
boulders, over and through which the current is swift and canoeing so diffi
and risky that it is often better to portage than to run it. Below this f
rapid is a basin or pond of still water, which is another characteristic of n
streams in the northern regions of the Province, and in less than half a n

[21] Niven's south base line in lat. 48° 45′ 30″, surveyed in 1891, runs through the sout
end of this lake and the western end of Elbow lake.

[22] An Indian name meaning Reindeer or Caribou Bone—caribou being Can
French for reindeer.

he river again widens into Magnetic lake. This lake is enclosed on all sides with green timber and dotted with prettily wooded islets, and is about a mile ong. Landing at a steep rocky portage at the end of this lake, a little north f where the river makes its exit through a deep ravine, we camped for the ight. Rain began to fall just as we reached the shore, and it rained heavily ntil 10 o'clock. Magnetic lake.

Tuesday morning we were astir at six, and I had time before breakfast to o down into the darkly wooded ravine and see the noisy rapids and falls. The river was reached at a quiet pool, below which there was a timber jam)n the opposite side the bank rose steeply to a height of 70 or 80 feet, covered vith small timber. About a hundred yards above was the foot of the first apid on this stretch. Going up through the jungle along the bank I observed t the head of the rapid a pretty cascade of ten or twelve feet high, divided y an islet; and although the water made a great noise in rushing through he rocks below, it was above as smooth as glass almost to the brink—flowing ently over a bed of rock as level as a table. It will not be long, relatively t least, until the deep channel is cut back to Magnetic lake, which is less han a hundred yards above the cascade. From a round cove on the right a orge opens through the slates parallel with the main channel, down which he water no doubt flows when the lake is high. The gorge and falls

We left camp at 9 o'clock, packing over a half mile portage which is easy xcepting at the lower end, where the descent is rough and steep. Here there s a charming view on the south side, where a band of rock 25 or 30 feet high nd perhaps 200 feet wide crosses the course of the river obliquely. Out of dark pool above this natural dam the water has cut its way by four separate hannels, and flowing down by dashes and leaps it is broken into foam in the nal jump of 15 feet into the deep water below. On the opposite side a steep ank covered with shingle rises about 30 feet to a background of green forest rees and extends about 150 yards below the falls. below Magnetic lake.

At 9.35 we set off down the stream, paddling, poling and wading by turns, an three rapids and entered Whiskey Jack lake. On the north side of this ake the banks are high and rocky, behind which rise a succession of parallel dges that have been surveyed and taken up as iron ore locations. At the oot of the lake is a short rapid of 15 yards, which the canoes ran when ghtened, and a quiet stretch of ten minutes' paddling was followed by another apid of the same character. Below this last, to the right, is a bluff of agnetic iron ore extending east and west 200 or 300 yards and conspicuous or some distance along the river. It is known as Iron Mountain, and the ange runs through locations 12E, 11E and 10E The largest exposure is een from the bend of the river nearly opposite the line between 11E and 0E. The valley is here a mile or more in width, grown with bushes, flags, eeds, rushes and coarse grass, and there is a channel three or four feet deep ost of the way to Sabawe lake, which we entered by a gap in the rock at 1.25. Whiskey Jack lake. Iron Mountain.

Sabawe lake has high banks on both sides. We skirted the north shore. here the rocky banks are steep, and at 11.50 reached a sand bar which Sabawe lake.

extends from the south shore nearly across the lake. It is only ten yard wide, rises one or two feet above the level of the lake, and is covered wit small cedar and tamarac. Here we halted for dinner and resumed the journey at 1.25 p.m. The lower end of the lake is wider than the upper, bu shallower, and with a head wind the choppy waves are hard to ride. The river debouches from the southern side, where there is a portage of 200 yard around a rapid, but the Indians were able to run the canoes down withou unloading.

Miles of iron ore locations.

Within the next three miles the river winds through a broad valley covered with coarse grasses and bushes, spreads out into several small lakes and is crossed in that distance four times by Niven's south base line. Half a mile below the last crossing it turns again westward, passing on its way by a number of exposures of iron ore whose brown-stained sides flank the river first on the north, then on the south, and on the north again, for severa miles, rising in the banks to heights varying from 20 to 70 or 80 feet Locations 400R and 401R, where the river bends to the west below the las crossing of Niven's line, present the highest and boldest exposures of ore, an upon these, as well as upon 212X on the south side, some exploration wor was done in 1891 with a diamond drill[23], which is yet housed upon th ground. At 404R, 139X and 238X, where the river runs southwest for hal a mile, the bluffs are 40 to 60 feet high, nearly perpendicular, and the brown stains are indicative of large ore bodies. But we had spent some time on th other locations, these could not be easily reached, and as it was after 6 o'cloc we hastened on to find suitable camping ground for the night. We reache it at the second of two rapids, where the river again turns to the west; bu as the woods had been destroyed by the last year's fire, it was a dreary spot

A channel with many obstructions.

Wednesday, August 28th, we had breakfast at 6.20 and were off dow stream at 7.40. It was a clear morning, with a bracing atmosphere, an good progress was made where the channel was favorable. At 8 o'cloc we came to the first rapid, below which a noisy little creek comes leapin down the bank from the south. A high ridge extends along the north ban and a little beyond it a lower one where Niven's line once more crosses th river from the south to the north bank, both of which show iron stains. Tw rapids and a timber jam were encountered in succession, after which came long stretch of uninteresting river with grassy bottom and a fringe of reeds an bushes on either side. A series of parallel ridges appear on the north side of th river, rising to heights ranging from 25 to 40 feet, and lower ridges on th south bank, all having an east and west course. Finally, at 9.20, we arrive at one of these ridges which extends across the valley, and which apparentl

Barriers of rock.

had one time dammed the waters of the river to form a lake. Indeed ther is evidence at two or three points higher up, notably at the foot of Magneti lake and at the head of Sabawe lake, that similar barriers of rock hav been broken through. The first falls on the river occur below Magnetic lak one at the head and another at the foot of the short ravine or gorge belo

[23]For accounts of iron ore deposits on the Atik-okan river, see the statements o Messrs. Conmee, McKellar, Wiley, Russell and Smith in the Second Report of the Burea of Mines, pp. 70-76.

the lake. The barrier we have now reached is about 40 feet high and the river has cut a channel across it to the depth of about 25 feet, with a width at the bottom of not more than ten or twelve feet. Through this the water rushes with great force, and a chute on the farther side descends fifteen or twenty feet in fifty yards, beyond which a rapid extends a hundred yards or more before quiet water is reached again. The portage here is over naked rock, steep and very rough in the descent upon the western side. A high, bold bluff of schist rises on the north side of the river below the portage, which continues for perhaps two hundred yards and another rapid and timber jam are reached. Here the portage comes in from the head of Steep Rock lake, across which Dr. Coleman and his party had come, and from this point to its mouth the Atik-okan was unknown to the Indians. Six rapids occur in quick succession, and between boulders and timber in the channel progress with the canoes was tedious and difficult.

The portage from Steep Rock lake.

Many trees had fallen since the previous year's fire, the earth which held their roots having been burnt away, and seemingly none of the explorers on the route have been interested enough to remove the obstructions. Like ourselves, each one had no doubt been concerned only in how to get through once, leaving to those who came after them the task of making a way for themselves. The clearing of canoe routes to and from the mining regions, such as this one (it may as well be suggested here) is work that might properly enough be undertaken by the Government; and indeed it is advisable that all portages should be improved as well as the streams. It would be a great boon to explorers if all the small timber on portages was cut away to a width of six or eight feet, so that canoes and packs might be carried over them with greater ease than is possible on most of them in their present state. In wet weather especially a portage through timber is a most disagreeable undertaking. Fallen trees too should be cut away, and some rude bridging constructed where necessary. Improvements of this character could be made at little cost, and when made they would be gladly welcomed by the hardy but often toil-worn explorers.

Improvement of the portages and river channels.

We left the portage from Steep Rock lake at 10.25, and the next hour was spent mostly in the water, lifting the canoes over obstructions of rock and timber, or guiding them over rapids, with here and there a basin fringed with rushes, grasses and lily pads. A portage of 50 yards leads around a fall of eight feet, where the river cuts through one of the ridges of green schist, so peculiar to this region. Its course here turns due north, and 200 yards farther on is another and more serious obstruction of the same kind as the last, or rather two of them in short succession, for there are two falls with a total descent of 50 feet. The last of these, which is also the last fall on the river, is quite picturesque. The stream is divided into two channels by a rocky island. The channel on the right is eight or ten feet wide and twelve or fifteen feet deep, and the water descends 40 feet by a series of leaps and falls to the pool below. The channel on the left is smaller, and before the final leap of fifteen feet is reached the water divides into three streams, pro-

A stretch of falls and rapids.

Last fall on the river.

ducing a very pretty effect. The portage is on the right side of the river, and is steep and hard at the lower end.

After dinner at these falls I walked down the right bank about a mile, hoping to find the posts of mining locations, and so locate our place on the map, but none were to be found; the fire had no doubt destroyed them all, although some of the lines were visible upon the charred trees. The land on both sides is black loam, and for some distance out from the river maintains a dense growth of fire-weed. Moose tracks were frequent, one of which was of enormous size. Several high ranges of rock extending eastward were observed on the right bank, and a band of rock crossing the river half a mile below the falls creates the only rapid worth noting for the rest of its length. At three places only were bands of rock seen below this point, and these are very narrow.

Through an alluvial valley.

From the time I entered the canoe again at 2 o'clock until we reached the mouth of the river at 4.45, its course was steadily one continuous "wind about, and in and out"; but never a "foamy flake" or "silvery waterbreak" like the poet's brook. All the way it flows through an alluvial valley, and for our first two hours of paddling with banks of sand, clay and loam six to twelve feet high, a channel contracted to thirty feet wide and four or five feet deep, bending at angles of 90° at intervals on the average of a hundred yards. Jams and snags are frequent, of course, but these offered no serious impediment. The low black soil on which lily pads flourish was literally ploughed with moose tracks, and all the herbage was cropped close to the roots; indeed this appears to be a typical moose country. The vegetation on the banks was very luxuriant, consisting chiefly however of low bushes, and with but few tracts of heavy timber. The mountain ash is frequent, and its red clusters of berries contrast very beautifully with the dark green of its foliage. The high-bush cranberry is plentiful also, but lower down the stream.

In a moose country.

Within about three miles of its mouth the river turns northward and is crossed three or four times by Niven's base line before it turns south again to resume a slow and tortuous course westerly to Steep Rock lake. Its waters hitherto have been clear, but now they become brown and obviously have reached the lake level; the banks are hardly perceptible, and the flats are flooded. Wild grass and rushes, with some rice, grow along the margins, affording cover and food for ducks, and the rushes extend far out into the lake.

Steep Rock lake.

Steep Rock lake owes the name to its high rocky shores, which rise almost perpendicularly out of the water. It receives from the east the brown waters of Lac des Mille Lacs through the Seine river, and discharges them to the west into the same river. The lower expansion of this lake is called lake Apunesigacen on the Geological Survey map, although there does not appear to be any good reason for a distinct lake name, there being no difference of level and the passage between the nearest opposite points of land is not much less than a quarter of a mile wide. A headland of rock on the north side of this expansion extends eastward about half a mile, rising 50 to 80 feet in

places along the shore, and behind it the Seine makes its exit swiftly through a narrow channel. A portage of a hundred yards across the neck of land between the lake and the river avoids this rapid, and we camped upon it for the night.

From our camp we could hear early in the evening the noise of the stamps at the Lake Harold gold mill, about three miles away in a northwesterly direction, and on Thursday morning the sound of the 6 o'clock whistle. This was the first sign of civilized life manifested to our senses since passing the lumber camp on Lac des Mille Lacs Saturday morning, and it was gladly welcomed. We had breakfast at 6 40, and at 8.10 our canoes were loaded on the Seine side of the portage.

Across the portage

We paddled up the river about 250 yards to get a view of the rapids. A short distance above them the river comes down from the east, then turns south and shoots through a channel narrowed to perhaps 50 yards wide into a bay or cove formed by the action of the water that looks dark and sombre in the morning shadow of the woods. Again the river turns to the west, flowing strongly down between banks of rock ten to fifteen feet high covered with a good growth of timber, chiefly Norway pines. Two hundred yards below the portage another rapid occurs, not so violent as the first, but full of eddies and cross-currents. We ran it easily and entered a stretch of river widened to 300 yards or more and dotted with a few small and pretty islands. Bending a little to the north two other small islands are approached, on the first of which we landed. It is about 150 yards long by 70 wide, oval-shaped, rising perhaps fifteen feet above the water line, and bears a few Norway pines of moderate size. Evidently this island is an old and favorite camping ground, and as I was to visit the Lake Harold gold mine our tents were pitched here for the day. A narrow gap in the northern bank opens into a bay or small lake, and through this is the entrance towards the mine.

into the Seine.

LAKE HAROLD GOLD MINE.

I was told that there is a canoe route from this bay up a creek into Rice lake, and thence a portage to Harold lake; but the map is misleading at this point, showing the creek to empty on the north side of the bay instead of, as I afterwards learned, directly behind the promontory to the right. We coasted the bay in vain for the stream, and coming to a trail on the north side which lead off in a northwesterly direction we decided after the loss of an hour's time to walk across to the mine. The trail was blazed out fairly good for a short distance, and the path was easy to follow, especially across a stretch of low swampy ground thickly carpeted with moss. But when a high ridge of rock was reached, over which a recent fire had swept, both trail and blaze were lost, and we took a straight line for the mill, the noise of whose stamps, which had been distinctly heard all the morning, served now as an unfailing guide. Across the ridge a descent was made into a low and broad muskeg, bearing a thick growth of small timber, and covered knee-deep with moss. Another high ridge succeeded, also fire-swept, and having struck the east line of mining location 275X we followed it north to the

By trail to the gold mine.

shore of lake Harold. Across the water were the white tents of the mining camp, while to the left, hidden behind a high point of rock, was heard the steady pounding of the stamp mill.

Inspection.

We arrived at the mill at 10.45, nearly two miles from our camp on the Seine, and after a short interview with Mr. Frank Gibbs, the superintendent in charge, the work of inspection was commenced. At one o'clock an appetizing dinner was served in the dining hall of the camp. Fried partridge served with onion sauce may not be good form in a fashionable menu, but a chef from Paris could not have done better for a hungry man. "Beef, and plenty of it," a man who sat beside me at a city hotel table many years ago said to the waiter who asked for his order. Partridge and plenty of it was our good fortune at Lake Harold gold mine camp; for partridges are so many and so tame in some parts of those northern woods that one may pick them off the branches of trees with a loop at the end of a stick, and no one asks or cares when the season closes or opens.

Location 219X.

Lake Harold gold mine is on location 219X, west side of lake Harold, and a mile and a half north of the Seine river. The lake is about half a mile across, enclosed on the north, east and south with a forest of Norway pine, gravel banks on the north and east, Huronian schists on the south and granite outcroppings on the west. The water of the lake is clear and of a greenish hue; the outlet on the eastern side has been cut to lower the level of the lake about seven feet, for the purpose of affording access to masses of ore which had fallen into the water from a vein upon the western bank; and I was told that at very little expense the level may be reduced an additional fifteen feet by cutting a trench of sufficient depth and fifty feet long at the outlet.

The discovery of gold.

The discovery of the Lake Harold mine was a mere result of chance. An Indian in the service of the Wiley Brothers of Port Arthur was employed six years ago prospecting for iron ores, and having reached lake Harold he brought away with him some samples of rock which were thrown aside as worthless. Two or three years afterwards however they were examined and found to contain gold. This induced the Wileys to undertake a little prospecting work in the region, and in the fall of 1894 considerable work was done, with such satisfactory results that they decided to develop the property. Accordingly, in the winter of 1895, a contract was entered into with Mr. C. S. Morris of Toronto, who undertook to erect a mill and equip it with ore-treating machinery on condition of acquiring a certain interest in the location, to be secured to him when the mill was completed and in running order. A battery of five stamps was ordered from the works of Fraser & Chalmers of Chicago, to be constructed of steel throughout, with a mortar in three sections to facilitate transportation, and battery, boiler and engine were taken in from Bonheur station during the month of March ove a winter road cut out from the station to lake Harold, a distance of 56 miles. A portable sawmill was taken in also as part of the outfit, to cut lumber for the mill, offices and other camp buildings. The contract was completed at the end of July and on 1st August the machinery was started.[24] From that

Building and equipping a mill.

[24] At the completion of his contract Mr. Morris sold his interest in the mine to Mr. Frank Gibbs of Port Arthur, and ceased his connection with it.

date until the time of my visit (August 29) it had been running 25 days of twelve hours, but the interruptions due to various causes made the actual working of the stamps only 117 hours. In that time 75 tons of ore were crushed, and the clean-up of the plates yielded a brick of gold weighing 46 ounces, or about $11.50 of free gold per ton. The pulp was not concentrated, but it has been stored awaiting the delivery of vanners. Analyses show, it is claimed, that the sulphides carry a good percentage of gold.

The mine and works.

The first lot of ore milled was taken from what is called the Lake Shore vein, in the face of a bluff north of the mill. Through the action of the weather a section of this vein has scaled off and fallen into the water, and to recover it the lake was lowered by a cutting at the outlet, as stated above.

Entry in the Inspector's Book.

The following entry in the Inspector's Book under date of August 29, 1895, supplies more detailed particulars of the mine and works :

"On behalf of the Inspector of Mines I have this day visited the Lake Harold gold mine and inspected the workings and mill.

"Cross-cuttings and other prospecting work have been done upon a number of veins on location 219X, but ore has been taken only from the Lake Shore and McComber veins near the mill, and from No. 1 and No. 2 shafts in the northwestern corner of the location.

"Open trench work and cross-cuttings have been made upon the Lake Shore vein, exposing it for a length of about seventy-five yards, and a shaft has been sunk upon it to a depth, Mr. Gibbs informs me, of twenty feet. It is now nearly filled with water, and covered with slabs for safety.

"McComber vein has been opened at the foot of the northern slope, where it is exposed, and stoped south fifty feet. Its depth at the north end is about ten feet, and seventeen feet at the end of to-day's working south, where it is intended to sink a shaft. The course of the vein is north and south, mag., and it dips 55° east. The hanging wall requires the support of stull timbers and a cover of lagging to prevent accident by the fall of loose rock from the surface.

"No. 1 drift is in the northwest corner of the location, and a tunnel has been driven eastward upon it upon an east and west vein a length of fifty-nine feet. This tunnel is six feet six inches high and four feet wide, and at its end the vein is two feet six inches wide.

"No. 2 drift is upon the eastern face of a ridge west of No. 1, and distant from it nearly three hundred yards. The vein has an east and west course, and has been stripped along the top of the ridge westward about seventy-five yards. The length of the tunnel is sixty-two feet on the vein, its height six feet eight inches and its width four feet. The width of the vein at the end of the work now in progress is three feet six inches. The dip is 60° north, and when stoping is undertaken the hanging wall should be securely timbered and covered with lagging if required.

"The mill is a frame structure, and is supplied with a Gates crusher No. 0, and a Fraser & Chalmers battery of five stamps with amalgam plate, driven by an engine and boiler from the works of H. W. Petrie of Toronto, stated to be about 30 horse power capacity. All parts of the plant are in

good condition, and when a railing is placed between the drive and balance wheels and the boiler room it will be reasonably safe against accident. It is necessary also that a railing should be placed on the stairs leading from the ground floor of the mill to the crushing room.

"The tramway from the Lake Shore and McComber veins is substantially constructed, and safe for foot travel over it if reasonable precaution be taken; but this is not its purpose, and no railing seems to be required for it.

"The other buildings on the location consist of (1) an assay office and store-room, (2) office and dwelling house, (3) dining camp, (4) men's sleeping camp, (5) stable, and (6) blacksmith's shop. There is also a sawmill of the Jenckes Machinery Co's make.

"There are at present nineteen men on the pay-roll, consisting of seven miners, seven surface laborers, one mill man, one engineer, one cook and two carpenters. Frank N. Gibbs is in charge as superintendent.

"Two copies of the Mining Regulations, made by Order-in-Council June 23rd, 1894, under section 6 of The Mines Act 1892, have been posted upon the premises, one on the principal door of the mill and one on the door of the boarding camp."

Back to camp on the Seine river.

It was five o'clock when the work of inspection was finished, and we were ready to start back to our camp on the Seine. No one at the mining camp knew the way out through the timber, and as the trail was very obscure in places we were advised not to attempt it, but rather to take the canoe route by way of Rice lake and its outlet. Mr. Gibbs kindly placed a birch bark canoe and two men at our disposal, but the canoe was a light, frail and leaky craft, and after crossing lake Harold to the portage on its eastern side it was considered prudent to go on the rest of the way without the men, the canoe being decidedly overloaded with them. Mr. Gibbs was not surprised that we had missed the canoe route up the creek, as this was almost everybody's experience, its mouth being hidden by a field of rushes. But the down trip was plain sailing, he assured us. We did not exactly find it so, owing to the low water in Rice lake and the obscure channel in a portion of it. The lake is about two miles long and half a mile to a mile wide; but in the summer season the wild rice covers perhaps two-thirds of its area, and to that extent its bed is then a shaking morass. We were directed to keep close to the right and make for a clump of pines at the lower end of the lake, where there is a bay, and continue down this bay to the creek which is the outlet of the water. This would be all right in high water, but it is misleading when the water is low, and we were obliged to explore the way for ourselves. In due time we reached the clump of pines, and paddled south into the bay, but the lower end was grown with water grasses and rushes and the creek was not discovered until we had entered it. It is a narrow, shallow and winding stream, full of weeds and snags, and obstructed in places by fallen trees; while its mouth and for some distance out into the bay supports a rank growth of rushes, emerging from which is a steep promontory on the left and the gap into the Seine. The day was very fine and the evening warm, and our clothes were fairly dried by the camp fire before the hour of bed-time.

DOWN THE SEINE RIVER.

Friday morning I was awaked at an early hour by a strong wind which blew up the river, and looking out at the tent door I observed that the sky from which the young moon shone down so brightly the night before was hidden by heavy clouds. A storm was brewing, and just as day broke the first drops began to fall, and then came a down-pour of rain with thunder and lightning which lasted for an hour or more. At seven o'clock it slackened, but in a few minutes a leaden-colored cloud which rose out of the west brought rain again in torrents until 9 o'clock. From that hour until 11.30 showers fell at intervals, and the storm gradually ceased. We had an early dinner and at 12.45 p.m. started down the river in the face of a strong wind.

Thunder storm on the river.

For two miles below our camp the Seine has a width of about 300 yards and holds a number of pretty islands covered with small pine. Norway pine and poplar also grow along the banks, which here and there rise into steep bluffs of rock 60 to 80 feet high. At 1.20 we reached the first rapid, where a point of rock projects from the south side and narrows the channel to a width of 50 yards. The waters descend swiftly, forming strong eddies and back water. Three rapids were run in succession, the first of them in a blinding rain. At the foot of the last, Eye or Deer river comes in from the north, and the Seine widens again to 200 yards or more. At 1.35 we entered Perch lake, which is a long and irregular sheet of water, or, strictly speaking, it consists of four sheets of water of different levels with three connecting narrows formed by contractions of the rock-bound shores, although the same name is common to all. The south side of the first of these expansions shows a good growth of pine, poplar, spruce, etc., while on the north side a fine grove of Norways sweeps around for a mile or more in the arc of a circle, with a fringe of poplars at its centre. At 1.53 we passed through the first gap, where a bar stretches northward from the south shore. At 2.13 we reached the second narrows, where a point of rock extends out from the north shore and an island occupies the channel; the current here is swift. Halting for ten minutes at these narrows we proceeded along the north shore to avoid the choppy waves of the traverse, and at 2.38 entered the third narrows. The fourth section of the lake is little more than half a mile long and perhaps one-quarter of a mile wide, with a long point of land (or possibly an island) cutting into it from the southwest.

A succession of rapids.

Perch lake.

We passed out of Perch lake at 2.53 and entered upon an exceedingly beautiful stretch of river, which is here divided into three or more channels by a number of large islands. Our course was down a swift current less than a hundred yards wide—on either side of us a dense forest of Norways with finely tapering boles of ten to fifteen inches diameter rising branchless to 80 or 100 feet, standing as close as they could grow upon a rich carpet of green moss, and through them the afternoon sun shinning like a purple haze—the scene was as delightful and perfect as any that I had ever beheld in water and woodland. At the end of a mile three of the channels reunite, and the river again expands into a lake of oval shape a mile and a half long and a mile wide, with a pretty islet in the centre. At its lower end, reached at

Fine and varied river scenery.

3.30, the rocky banks contract to a width o 40 yards or less, where there is a swift rapid of 200 yards, and by a singular coincidence this as well as several others that afternoon were run in the face of beating rain. A series of three lake expansions of a quarter mile to a mile wide follows. We skirted the north shore of the third and longest because of the high head wind which came in frequent gusts, for these small bodies of water are quickly stirred up to the unsafe point for a canoe. Green timber prevails on both shores, with considerable Norway pine of moderate size; along the north side of the third lake, near its lower end, fire has done some damage to spruce and poplar, but seemingly none to the pine.

The exit from the last of these three nameless lakes was made at 4.30. The river's banks are contracted to a width of 100 to 150 yards, and it is studded with islets covered with small spruce and cedar, forming a charming piece of scenery. At 4.38 we arrived at the first portage, where the river falls 7 or 8 feet. It is much better beaten than the portages on Atik-okan river, doubtless owing to the fact that the lines of travel by the Seine and Atik-okan have converged. The banks are densely wooded with pine, tamarac, spruce and balsam, but none of the trees are large. The portage is not more than 100 yards long, and we were off again at 4.55. At 5.20 we came to another rapid or small fall, where the river drops about three feet. The canoes were let down through a channel five feet wide, upon the north side, without any trouble of portaging or more than a few minutes delay. Below is a continuous rapid through a maze of islets, and at 5.30 we came to the head of a long portage and camped upon it for the night. This portage is a little more than half a mile long, passing by three falls on the Seine before Calm or Nonwatin lake is reached. At the first of these falls the river takes three successive leaps over ledges of rock, presenting the appearance of a terrace of waters. At the second falls the river is divided by islets into four or five channels, through which the waters rush with great force, forming a tumult of eddies and cross currents where they meet below; again to divide into two streams before making the final plunge of ten feet into Calm lake. The rapids and falls in this part of the river, with the scores of wooded islets which occupy its bed, compose a varied and delightful bit of scenery. From the foot of Perch lake to the level of Calm lake the descent of the river according to Dawson's profile route is 29½ feet, and from the level of Steep Rock lake it is 39 feet.

Falls, rapids, and a maze o islets.

Our plans were laid to reach Shoal lake Saturday evening, if possible; but the distance is about forty miles and there are thirteen portages around falls and rapids on the river. We rose at 5 o'clock, breakfasted at 6, and left the portage and falls at the head of Calm lake at 7.15, pursuing a northwesterly course. It was a fine sight in the early morning, for although it was only the last day of August the foliage of the poplars which crowned the long slopes towards the east and north was beginning to take on a golden hue, to which an added lustre was given by the bright sunlight. The sky was clear save for a fringe of gray cloud on the western horizon, and the waters of the lake were in keeping with its name. But before we had paddled a

Calm lake.

third of its length the sky was overcast and we were struggling with a head-wind. The shore of the lake on the southwest side is rocky, with a fringe of cedars along the water's edge, and behind them spruce, poplar and Norway pines ; on the northeast there are stretches of sand banks, and the timber is mostly poplar and Norway pine. Niven's south base line crosses the lake at its widest part, about midway between the extreme ends. Beaver river comes down from the north, and is the only stream of importance that was observed to flow into the lake. On both sides, near the lower end, surveyors' lines were to be seen, where a number of mining locations had recently been laid out.

Rapids, falls and portages below Calm lake.

We passed out of Calm lake at 8.18, and the Seine again becomes a rapid-flowing river, with a number of low islets covered with bushes. At 8.25 we ran rapids, and at 8.35 reached falls where the river divides into three streams. Other falls occur 200 yards lower down, and the two portages were crossed in less than half an hour. At 9.05 the head of the next portage was reached, which is half a mile long and very rough. Two falls and tumultuous rapids are overcome by it, and the descent in that distance is 50 feet or more. The rapids below the second falls were run by the Indians in empty canoes, each one standing upright, and uttering wild yells of delight as his canoe leapt from crest to crest of the waves.

From the foot of the portage, which was left at 9.50, the river runs northward into a cul-de-sac to turn again due west. A bay on the north side 250 yards in length and 100 yards wide at its mouth is suggestive of an old river bed, but we had no time to explore it. A rapid was run just below it, and at 10 o'clock we reached falls and rapids at the base of a high rocky bluff, where a short portage had to be made. The width of the river here is not more than 40 yards, and the channel looks like a canyon cut out by water or ice. An unfinished channel parallel with it on the south side is beautifully grooved for a length of 25 or 30 yards, and is covered with glacial scratches.

"Pretty danger rapid here," Nicol said, as at 10.10 we left the foot of the short portage, and it was certainly a swift, narrow and deep current, with the north bank rising perpendicularly to a height of probably 70 or 80 feet. On the left the river expands into a bay, the shore of which is thickly covered with timber. At 10.15 another portage was reached, the river contracting to thirty yards, falling six feet abruptly and rushing off into a very swift and noisy rapid. The portage is about 300 yards long, and we completed it at 10.30. For the next mile the river is like a canal, running due west, with a high steep bank of rock on the right, cut at one point by a deep notch that looks like a closed-up channel. Below it is a small lake, out of which the river flows in a northwesterly course in swirls and eddies, forming a bay upon the east side and turning again towards the west. At the bay a deep depression extends toward the northeast, which has the appearance of an old river bed. The general course of the river from Calm lake to this point is northwest ; and then for several miles it runs southwest.

Survey of a new township along the river.

We called at Proudfoot's camp below the bay at 10.50, where a new township was being surveyed ; but although a number of instruments were hung upon the trees, it was evident that the camp had not been occupied for several days. Five minutes paddling brought us to a bend where the river turns due south, and is divided by an island into two channels. We took the narrower one to the left through strong rapids, and at the end of 200 yards, where the streams rejoin, the river again turns southwestward. The north bank for some distance is alluvial, and is heavily covered with small timber. At 11.05 falls are approached which are observed to be divided by an island, the main portion of the river going down the channel to the right. The portage here, like the two preceding ones, is on the left bank, whereas all others that we had crossed on the Seine are upon the right bank. Its length is 300 yards. The strong current descends into a quiet bay or pool, which no doubt is of its own making, out of which the waters escape through a gap less than twenty yards wide, formed by the projection southward of a point of green schist fron the north bank. The flow is exceedingly swift and strong, but by lining the canoes down close to the shore little time was lost in getting into safe water again. We had left the last portage at 11.25 and the decharge at the gap at 11.40. The course of the river continues southwest with a good current, and at twelve o'clock we reached the head of a portage where the river is crossed by Niven's south base line. Numerous locations have been surveyed along the river from Calm lake, many of them connected with the section of the line between the lake and the river westward, but little or nothing is yet known of their mineral value. The portage is across a gravel bank 20 or 25 feet above the river, and is about 300 yards long. The channel of the river is full of large boulders, and the rapids are altogether too violent for canoeing.

Mining locations.

A stretch of river within alluvial banks.

We had dinner at the foot of the rapids, and set off again at 1.30 p.m. Five of the thirteen portages had yet to be made, and about twenty-five miles of river and lake, and it was obvious that we could not hope to reach Mine Centre on Shoal lake before nightfall. For a mile from the crossing of Niven's line the river runs about southwest, with one or two sharp bends to the south, after which its course for three or four miles is nearly due west. Excepting at the turns, where bands of rock cross the stream forming rapids, the banks are alluvial. The valley widens on the right, but on the left the the bank rises 20 feet above the water. The timber is mostly white birch, spruce, balsam, etc., and I think this is altogether the most beautiful

[25] The township of Bennett. It's location is described as follows in Mr. Proudfoot's report to the Department of Crown Lands : "The township of Bennett is situated on the Seine river, Rainy River district, and is bounded on the south by Niven's south base line, on the north by Niven's north base line, on the west by Niven's fifth meridian line, and on the east by unsurveyed lands of the Crown. The Seine river enters the township at the middle of the east boundary and following in a general southwesterly direction, with numerous rapids and falls, leaves the township about the middle of the south boundary. All that portion of the township lying south and east of the Seine river, with the exception of seventy acres, has been taken up as mining lands and surveyed into mining locations. Mining locations have also been laid out along the south and west boundaries and north of the Seine river." All these locations have been taken up for gold-bearing quartz, Mr. Proudfoot states in his report, excepting two on the west boundary upon which there are indications of iron ; from many of the veins gold can be obtained by panning.

reach of the Seine. Just above the next falls a white man and a woman were met in a canoe, the first human beings we had seen since leaving lake Harold. The man said he was prospecting for gold, and had been out several days. The woman protected her face with an old-fashioned and closely drawn sunbonnet, and she may have been of any colour, red or white; the proximity of an Indian reserve suggested the former, and the sunbonnet the latter.

We landed at the portage above the falls at 2.15, on the right bank of the river; packed over the bare rocks of green slate standing on edge 100 yards, to load up and run a rapid of 50 yards to a rock which in high water is an island, and packed again over rocks 75 yards, around another falls to quiet water below the island. Both these falls are divided by little islands, the upper covered with small timber and the lower mostly naked. The left hand channel of the second falls or chute is a narrow chasm through which, owing to its peculiar shape, the water curls like a screw. Off again at 2.35 down a fine bit of river, and at 2.43 we came to another falls, around which is a good portage of 200 yards across a point covered with Norway pines and cedars. The channel is contracted within walls of rock to 30 yards, drops about 10 feet perpendicularly, with a swift current below. At 2.55 we paddled away, borne quickly down the stream, and at 3 o'clock reached a fine clean chute having a descent of about 10 feet in a channel 30 yards wide. The portage is 200 yards long, and we left the foot of it at 3.10. Below the rapids is a charming pool fringed with grass and water lilies, and its banks are densely covered with white birch, spruce and balsam.

Another series of falls and rapids.

The portage above Sturgeon falls was reached at 3.25, and is about 100 yards across. The falls are not perpendicular, as I had supposed, but form three successive terraces with a total drop of 12 feet. The channel has a width of about 35 yards, and is filled with boulders. The timber on the banks is principally spruce, balsam and white birch. The river below the falls lies in a gorge about 200 yards long, and for at least a quarter of a mile it is a strong current, full of eddies.

Sturgeon falls.

Sturgeon falls is the head of navigation on the Seine river. This was our last portage, and we paddled away from it at 3.35. The thirteen portages and one decharge from the camp above Calm lake had occupied an aggregate time in packing across them of 3 hours 37 minutes, or an average of 24 minutes for each one.

The Indian reserve known as 23 B2 lies on the north side of the river and extends from a point a little above the falls about five miles west. On the south side of the river a number of mining locations have been surveyed, on one of which near the falls a new log building was in course of erection.

A mile below Sturgeon falls the river expands into a small lake about three miles in length, with low and well-timbered banks on each side. The exit from this lake was made at 4.45 and at 5.25 we entered Wild Potato lake to land at a point of naked gray schist on the south shore at 5.30, where tea was made ready. Indian reserve 23 A occupies both sides of the river

Wild Potatoe lake.

below 23 B2, and for half way down the lake. On the north side of the lake, and near the upper end of it, is an Indian village of a few houses.

From our landing point on Wild Potatoe lake to Mine Centre on the north side of Shoal lake the distance is nine miles, or possibly ten by the canoe route. We left on this last stretch at 6.23, narrowly escaping an upset with one of the canoes at the start, owing to undue haste. Around the point the lake is full of weeds and reeds for the greater part of its length, and with the level glare of the sun in our faces the situation was not very agreeable

Coasting along the south shore, a large porcupine was observed on a tree which had fallen out over the water, the second wild animal that we had seen in all the wilderness region traversed since leaving Savanne. But it is hardly correct to class the porcupine with wild animals, its motions being those of a supremely indifferent one. We paddled up within four or five yards of this fellow, and although almost near enough to hit him a blow with the paddle he sat up and stared at us very composedly; then, when a motion was made at him, he turned and walked slowly away along the tree, with the quills of his back and tail upon end, pausing every two or three steps to stare at us over his shoulder through his black beads of eyes. A crying shame it would be to to attack a beast that reposed such colorable trust in man, although it is more likely that his real trust was in the defence of his quills.

The Porcupine.

The lake expands below the pine-covered point on the south side, which we passed at 7.15, and the last rays of the setting sun were pinking the tree tops on the eastern hills. It was a lovely evening, with brilliant cloud effects shading from crimson to blue in the west, and as the light of the sun faded slowly away the mellower light of the moon shone down upon the water, casting dark shadows along the wooded shores.

Shoal lake and Mine Centre.

Our exit from the lake was made at 7.35, and in the two miles to Shoal lake the river has a breadth of 300 to 400 yards, looking in the golden evening light between its low banks covered with poplar like a magnificent avenue. Paddling by a number of wooded islands, Seager's camp, which is a village in embryo, was passed at 8 o'clock; five minutes later we entered Shoal lake, which was one mass of weeds, and at 8 30 we landed the canoes on the rocks at Mine Centre and were made very welcome at the only "hotel" in the place —especially by Jack Bedford the cook, who is a character in his way, with much experience of the world.

At and Around Mine Centre.

As I intended to remain several days in this district to visit mining properties, and especially those upon which work had been or was being done, the Indians, Alec and Nicol, were paid off and they proceeded to their homes on the reserve near Fort Frances. Mr. Cameron also left for the Fort by canoe, to take the boat there for Rat Portage and return by rail to Fort William. He was delighted with the trip by canoe from Savanne, and gained an idea of the vastness of Ontario which is hardly obtainable on such a scale in any other way. Especially is the Seine river calculated to arouse one's enthusiasm by its volume, varied scenery and natural beauties. There is no river in lower Ontario to surpass it excepting such boundary rivers as the St. Lawrence and the Ottawa; and if the portages were improved I cannot conceive of a finer canoe route than is afforded by the rivers and lakes from Savanne to Fort Frances, or to Rat Portage if one so desires. Ending the long canoe trip.

Mine Centre is on a point of land on the east side of an unnamed bay at the widest part of Shoal lake. The village consists of a general store, an assayer's office, a bar-room, a small boarding house and two or three other buildings; and a larger and more substantial boarding house was in the course of erection. The Keewatin schists stand on edge, and the only soil in sight may be measured in handfuls, lying in crevices between the ribs of rock. Across the bay may be seen at night the lights at the Wiegand mining camp; and three miles to the southwest the lights of the more pretentious Seine River City. All around the lake is a dense wood of poplar, and on the high ridge towards the north, a mile or more from the lake, is what remains of a pine forest, now for the most part cut over by the lumbermen. The wooded slope of the lake, curving around its many bays, is remarkably adapted to the reflection of sounds, several demonstrations of which were given in the quiet evenings by Jack Bedford. Standing on the rocks at Mine Centre, he would utter a loud and ringing halloo across the bay to Wiegand's, the echo of which would return in eight or ten seconds; a few seconds later it would be heard from the northeast side of the bay, then from the south side of the lake, again from the northwest side, and so resound and reverberate six or eight, and on a very still night, ten or twelve times, to die away at last in the direction of Seine River City. Mine Centre, Shoal lake, and the sights and sounds thereof.

A Government road was in course of construction during the summer from Mine Centre northward to the mining locations between Shoal and Vermilion lakes, which was completed during the time of my stay in the locality. It has been cut out and grubbed as far as the old lumber road, and graded up over the low ground; and a very passable road is the result, made at a cost of $600. The intention is to extend it as far north as Vermilion lake, and probably on to Turtle lake. A number of mining locations lie along it, on several of which some work has been done. A Government road towards Vermilion lake.

Hillier or Lucky Coon Mine.

The first location reached by the new road is known as the Hillier or Lucky Coon mine, 655P, consisting of 167 acres. It is at the terminus of the road, and about midway between Shoal and Vermilion lakes. It is Hillier or Lucky Coon mine.

embraced in what is known as timber berth No. 33, upon which the pine timber was cut four or five years ago. The first discovery of gold was made on 28th July, 1894, by William Campbell, who had associated with him as prospectors A. M. Robertson and John Mosher. The vein is known as No. 1, and crosses the property in a course of northwest and southeast. Another vein, known as No. 2, was discovered a week later by Mosher a short distance north of the first. Its course is west-northwest and east-southeast. Both veins are exposed in a ridge of granite which runs north and south on the property, but towards the east and west sides they are covered over with several feet of sand. The No. 2 vein appears to outcrop on location AD4, west of 655P, where some work has been done by Campbell, Fawcett & Co. No. 1 vein is supposed to extend into location AD2, and apparently it cuts No. 2. In November, 1894, Robertson discovered a third gold-bearing vein on the property, which is known as No. 3. It lies on the eastern side of the location, and its course is nearly east and west. Besides these there are ten or twelve stringers or branch veins, all of which join with one or other of the three principal veins described above.

Working the location.

In August, 1894, a syndicate composed of Hugh Steele and George Hillier of Duluth and Walter Miller of Minneapolis entered into an agreement with the owners of the location, whereby they undertook to pay $1,800 cash, build a five-stamp mill, and work the mine and mill on a basis of half the net profits. Any further additions to plant and cost of working the mill and mine were to be provided for out of the profits. Under this arrangement mining operations were started on No. 1 vein on the 20th of September, and a shaft 6 by 8 feet was sunk to a depth of 20 feet. Soon after a shaft 8 feet square was commenced on No. 2 vein and was put down to a depth of 50 feet. This work was completed about 15th December, when mining was suspended until the mill should be built and got into running order.

No. 2 vein is about 3 feet wide at the surface, but increases to 10 feet 4 inches at the bottom of the shaft. A wedge-shaped horse of country rock occupies the middle of the shaft from some distance below the surface to the bottom, having a thickness of two feet above and decreasing to ten inches below. After the mill commenced running a level was drifted from the shaft at a depth of 25 feet and extended 15 feet towards the west. The dip of the vein is about 80° southwest. The ore from this as well as from No. 1 shaft is fine looking, and many specimens show free gold.

Mill for treating the ore.

The main part of the mill is a frame structure, of size to accommodate two five-stamp batteries, while a log lean-to provides shelter for the boiler. The machinery consists of a 35 h. p. engine and boiler, supplied by a firm in Erie, Pa., a Gates five-stamp battery, and a Blake crusher. There are no vanners or other concentrating apparatus, the pulp after passing over the plate being carried off to the dump. A tramway of 300 feet was constructed from the No. 2 shaft, on which the ore was elevated to the third floor of the mill, to be crushed and fed to the battery. The mill was started on 14th April, 1895, in charge of William Peters (subsequently in charge of the Lake Harold mill) and work was carried on without interruption for 25

days. The machinery ran well, and I was told that two bricks of gold were produced, the value of which was not known to the original owners. The mill was run night and day, and the quantity of ore stamped is given as 250 tons. At the end of that time some disagreement took place between the members of the syndicate and Messrs. Campbell, Robertson and Mosher over the supplying of machinery to concentrate the pulp and treat the sulphides, and failing to agree the works were closed down. Other causes and motives are mentioned as influencing the action of the syndicate; but there are two sides to the dispute, very probably.

Miners, laborers and millmen to the number of fifteen were employed while work was in progress, the rate of wages being $1 to $1.25 per day and board. A comfortable boarding house of squared timber, blacksmith's shop and stables are on the location, besides the mill.

LOCATIONS AD2, 3 AND 4.

Locations AD2, 3 and 4.

Lying to the west and northwest of 655P are locations AD 2, 3 and 4, which are held under lease by Messrs. Campbell, Lavin, Fawcett and Handlan of Duluth, embracing in all 160 acres. Gold was discovered on AD2 in March, 1894, and in the following month the three locations were surveyed. The vein on AD2 is apparently a continuation of No. 1 vein on 655P. It runs along the northeast face of a granite hill and is well exposed for a length of 300 yards, pinching out towards the north where the granite comes into contact with the green schist. Two openings have been made upon it, one to a depth of 10 feet showing solid quartz of 16 inches wide and a number of stringers; at the bluff on the northwest side of the hill a cross-cutting has been made to a depth of 15 feet, where the formation changes, and there the vein is apparently cut off. Another vein on the same location has a course nearly east and west, and on the northwest face of the bluff approaches within 30 yards of the first vein. Trench work has been done upon this end to a depth of 15 feet, and at the contact the vein is not more than a foot wide. Farther east, in the granite, it widens to three or four feet, as shown at several points where it has been stripped. The development work was carried on upon these veins during April, May and June of last year, when five miners and three laborers were employed. The other two locations have gold-bearing veins also, but little or no work has been done upon them.

THE FOLEY MINE.

Wiegand Gold Mining Company.

The Foley mine.

The only active mining work in the district at the time of my visit was carried on upon locations AL74 and 75, about two miles west of Mine Centre, and known as the Foley mine. These properties are reached by canoeing across the bay to a dock upon the point marked on the map as Wiegand P.O., from which a good road has been constructed half a mile north to the mining camp. The details of the work carried on are furnished in the following entry, which I made in the Inspector's Book under date of 2nd September:

Entry in the Inspector's Book.

"This day I visited on behalf of the Inspector of Mines locations AL74 and AL 75 in the Rainy Lake district, and found Mr. Joseph C. Foley in charge of the works for the Wiegand Gold Mining Company.

"The Company, organized under the laws of the State of Minnesota, are leaseholders from Mr. Foley of AL75 for a period of ninety-nine years (Mr. Foley having purchased from Messrs. Wiegand, Ray and Green on 16th November, 1894), and on 20th July, 1895, they procured an option on AL74 and AL 76.

"A vein having a course about 10° west of north appears to extend across locations 74 and 75, the width of which at outcroppings varies from eighteen inches to three feet.

"On No. 5 vein, AL75, a shaft 6 by 9 feet has been sunk to a depth of 44 feet. The width of the vein at the surface is eighteen inches, but pinches to a foot or less in places in the shaft. The dip is nearly perpendicular for about 25 feet, when it changes to 80° east. The formation is solid, and with 14 feet of substantial crib work at the top of the shaft it appears to be safe for carrying on development work.

"On location AL 74 a shaft, called the Bonanza, has been commenced upon what is believed to be the same vein, on the hanging wall, and has been sunk to a depth of six feet. The width of the vein is three feet, and its dip 72° east. Its course is about 10° west of north.

"At the northeast corner of AL 75 a shaft has been put down on what is known as No. 9 vein. It is 5 by 6 feet, well timbered to the water, which rises to within ten feet of the surface. The depth of this shaft is said to be 31 feet. The width of the vein at the surface is 2 feet 9 inches, and its course nearly north and south.

"Machinery is in course of being placed at the shaft on No. 5 vein, AL 75, manufactured by the Ingersoll Rock Drill Company of Canada. The plant consists of two boilers, one of 30 and one of 20 h.p.; and two engines, one rated at 30 h.p. to drive an attached air compressor, and one at 25 h.p. to drive a double drum hoist which is intended to serve each of the two shafts. Steam was got up in the larger one of the boilers to-day.

"Water for the boilers is procured from a dam erected upon a small creek about 600 yards distant, which is lifted through a two-inch pipe by a force pump to a tank at the engine house.

"The buildings are on AL75, and consist of a tool house, blacksmith's shop, cook camp, office, miners' sleeping camp, assay office and powder magazine.

"There are in all 22 workmen employed, including 6 miners who work day and night shifts in the shaft commenced on location AL74. The others are carpenters and laborers.

"A good road has been built from a dock at Shoal lake north to the shaft on AL75, and is being continued to the Bonanza shaft on AL74."

The Wiegand Gold Mining Company was formed early in 1895, and the purpose of the Board of Directors, as stated by Mr. Foley, is to sink each of the two shafts to a depth of 400 feet, and to further prove the ground by drifting along the vein or veins (for it is not absolutely certain that the two shafts are on one vein) before any steps are taken to erect a mill for treating the ore.

Reports of progress.

Through Mr. Charles J. Hollands, the Crown Lands agent at Fort Frances, I have received information of the progress of work on those two locations down to the middle of March. Mr. Hollands reports that the shaft on AL 74 had, on the day of his visit, reached a depth of 200 feet, the size of it being 8 by 10 feet. At 100 feet a level had been driven along the vein 43 feet; another at 150 feet, a length of 18 feet; and a third at 200 feet was just commenced. At the surface the vein was 42 and 36 inches respectively at opposite sides of the shaft, while at the bottom it was 26 inches, and the average from top to bottom was 20 inches. About two tons of ore were shipped to New Jersey for treatment, "and the results of this experiment and the developments on the property between this date and the first of June will determine whether the Company will take the property or not. If they take it," Mr. Hollands writes, "which is altogether likely, a twenty-stamp mill will be at once put on the property." The shaft on AL 75 had been sunk to a depth of 113½ feet, and at the bottom the vein was "split up into a number of small stringers, none of them more than a few inches. The walls however are good, being, in mining phraseology, slickensided. No drifting on the lead has been done as yet, and work on this shaft has been stopped for the present."[26]

LOCATIONS AL 103, 104, 105 AND 106.

Locations AL 103, 104, 105 and 106.

Locations AL 103, 104, 105 and 106 occupy a block about a mile north of Shoal lake, and nearly north of AL 74 and 75, each comprising 40 acres. They were surveyed and taken up in August, 1894, by Messrs. A. Lougheed, William Wiegand and Charles J. McLean. Prospecting work was done on each of them last summer, four men having been employed steadily since the middle of April. Headquarters are on AL 106, where a camp has been built. Three veins on AL 103 have been explored by pits, crosscuts and trenches. The most easterly of these veins is across the northeast corner of the location, its course being nearly northwest and southeast. It has been stripped at two points, and at one place shows a width of 12 feet 8 inches. Farther on it is broken, and the width is reduced to 6 feet. The same vein extends into AL104, and where stripped at the southeast corner of it the width is about 2½ feet, showing free gold. For a great part of its length this vein consists of white quartz, carrying some iron pyrites; and in other places

[26] The Wiegand Gold Mining Co. has this year disposed of its locations to a new proprietary, organized as the Ontario Gold Mining Company, composed of capitalists in New York and Detroit, with J. C. Foley as general manager at the mine, Rodolph A. Demme of Detroit as president, and Colonel Thomas J. Hurley of New York city as treasurer. An official report made by the general manager under date of 15th July (as this report is going through the press), shows that the deeper (No. 3) of the two shafts sunk on what is called the Bonanza vein had reached 210 feet, with a drift of 97 feet on the 100 foot level, of 116 feet on the 150 foot level and of 85 feet on the 200 foot level. The report states that at the second level the vein at the end of the south drift is very strong, while at the end of the north drift of the third level it is a little over 5 feet wide, "showing free gold and looking extremely well." The No. 5 shaft had been sunk to 113½ feet, and on other veins six pits or shafts had been opened to depths ranging from 6 to 31 feet. A new vein had just been discovered on the southern end of the property which is described as very strong in free coarse gold, "thus making on our property," Mr. Foley says, "nineteen well-defined veins, the largest of which is 8 feet wide." Work is in progress for setting up a twenty-stamp mill, which the manager hopes to have in running order in October. "Please note," he observes of the Bonanza vein, "the gold does not form in large nuggets, but is evenly disseminated through all the vein; that is to say, that while some of the vein matter is richer than others, it is not a vein with a pay streak, as there is no barren rock. Everything between the walls brings good milling ore, and all will go to the mill."

Exploration work.

the quartz is of a reddish or rusty brown color. Its length, as shown by exploration on 103 and 104, is 1,500 feet. Where it crosses the crown of the ridge on 104 the vein is finely polished and rounded by ice action, and shows glacial striae running east and west. Little work has been done upon the other veins of 103, but enough to show that they lie parallel with the larger vein; they vary in width from 2 to 6 feet. On 104 no other vein is known to exist but the large one above described. On 105 there is one vein with a course 25° west of north, with a ruddy looking ore that carries some free gold. It has been traced ten chains on 103, and samples of the ore pan gold. On 106 there are two veins, one of which is broken up in the country rock and gives many showings of free gold near the surface. A pit 10 feet deep opens a vein 6½ feet between the walls, but enclosing in the quartz a horse of country rock 2½ feet wide. It has been crosscutted at three other points farther north, at all of which the ore gives gold colors in the pan. On the west side of this location is another vein running nearly north and south, 8½ feet between the walls—2½ feet of quartz and 2 feet of slate on each side of it. A pit 6 feet deep has been opened on this vein, and the ore shows a little gold when panned. The owners had expended, to the time of my visit, $1,200 in development work, and intended to carry on operations until October.

The descent from the granite bluff north of the camp on AL 106 to the level of Shoal lake, a length of half a mile, is 170 feet, as indicated by an aneroid. The lake itself changes its level much between high and low water, and owing to the gentle slope of its bed the shore line shifts in places as much as 50 and 75 yards between high and low water marks.

Mine Centre to Fort Frances.

By steamer to Fort Frances.

The steamer Maple Leaf was put on the route from Fort Frances to Mine Centre in the early spring, and while there was a rush of explorers she made three trips weekly. But traffic fell away during the summer, and for some time she ran two trips weekly. In September she made only one trip weekly each way. We left Mine Centre at 9.07 in the morning and at 9.40 called at Seine River City, where the Seine river emerges from Shoal lake. The site is on the north bank of the river, and the "city" itself consists, besides two or three small houses, of two hotels, one of which is a frame building, which alone was occupied; the other is built of squared logs. Surveyor Proudfoot had his head-quarters in a capacious tent; and besides him the chief citizens were surveyors Roland and McCallum.

Seine River City.

We left the city at 9.55 and after steaming down a mile of river entered another shallow expansion known as Grassy lake. A stream coming in from the north brings down the waters of Vermilion lake. At 10.30 we reached the foot of the lake and tied on the south bank to wood up for the lake trip. This occupied three-quarters of an hour, and in another half-hour we reached the mouth of the Seine at Kettle point, and entered the northeast arm of Rainy lake known as Seine bay. There is a fine bit of scenery down

Shoal lake to Rainy lake.

this bay, and indeed for the whole length of the sail over Rainy lake and among its scores of islands; but the fog, mist and rain which prevailed during half the passage interfered to some extent with the sights which the lake affords.

I had intended calling at the Lyle gold mill and mine, which we passed about midway down the lake, but was told by the captain that the Maple Leaf is not allowed to land passengers at American ports or posts. That is a privilege, it seems, that is only shared by boats duty licensed, or boats flying the American flag, although I did not see or hear of an American flag on the lake. However, the mill was idle, and it was reported that the mine did not contain any ore. Sand Point City on the Ontario side of the boundary, nearly opposite the Lyle mine, is a city with one inhabitant.

Lyle mine and Sand Point City.

Besides the Seine river, Rainy lake receives several tributaries from the north, and a large volume of water pours into its southeast arm from the chain of lakes along the international boundary. Its outlet, the Rainy river, is therefore a much larger stream than the Seine, and one gets an experience of the strength and force of it at the outset, in the seething rapids which play see-saw with the boat at the rounding of Pither's point, where the river emerges from the lake. Our exit was made at 3.15 p.m. and the boat tied up at her dock at Fort Frances at 3.30. The distance from Mine Centre in a straight line is 36 miles, or by the course of the boat about 42 miles, and the actual running time was 5 hours 23 minutes.

Rainy lake and its outlet.

THE TOWN OF FORT FRANCES.

Fort Frances has grown little since my first visit to it in 1891. A few new dwellings have been erected in the eastern part of the town plot, near the river front, and other handsome cottages were in course of erection; but the business part of the town has not changed, and hardly an attempt has been made at street building. It is however a beautiful site for a town, viewed from the river either above or below the falls; and the ease with which a system of sewerage may be introduced, superadded to the natural advantage which a dry sandy soil affords, makes the problem of sanitation a very simple one. Fort Frances ought to be a delightful summer resort, with its fine climate, bracing air, pretty scenery and facilities for boating. The graceful long-branching ashes, elms and oaks[27] at Pither's point suggest a very desirable improvement which might be made by the planting of shade and ornamental trees, for the town plot is almost bare of tree life. At present Fort Frances is the head of navigation on Rainy river, for although a lock to overcome the falls was commenced twenty years ago it is not completed yet, the work having for some cause been abandoned in an almost finished state when the change of Government took place at Ottawa in 1878. With this lock ready for use boats could run without breaking bulk from Rat Portage to Kettle falls on the Namakan river, to Sturgeon falls on the Seine, and to all

The site of Fort Frances.

Fort Frances lock.

[27]Sir Alexander Mackenzie, who travelled in the country about a hundred years ago, mentions only oaks as the trees of the point. Mr. C. J. Hollands, Crown Lands agent at Fort Frances, writes me that "the timber at the point is mixed oak, elm, ash and soft maple, the elm and ash preponderating."

points along the extensive and sinuous north coast line of Rainy lake. It would be a great boon to lumbermen and miners operating around and above the lake, and could not fail to be a benefit to Fort Frances also. The completion of this work is all the more desirable now in view of the early settlement of lands on the American side of Rainy river. The water power at the falls, now running waste, will no doubt be utilized in a very few years, and will not fail to add to the prosperity of the town. The rich agricultural lands along the river, the extensive forests of pine and pulpwood upon Rainy lake, its long arms and tributary rivers, and the discoveries of gold-bearing ores in many localities north and east of the lake easily reached by small steamboats and canoes, give promise of the establishment of industries here which will make the district one of the most prosperous in the Province. A town has been started on the Minnesota side, opposite Fort Frances, but as yet it contains only ten or twelve houses.

Pioneers of the region.

The fur traders were the pioneers of the region, and as long ago as 1731 La Verandrye built Fort St. Pierre at the head of Rainy river, on what is now called Pither's point. The ruins of this fort, Mr Pither has informed me, may still be seen there : but a more noticeable feature is the Indian mound on the point, close to the rapids.[28] Some time during the last century the Hudson's Bay Company established a post on the right bank of the river, below the falls, on the same site as the one which the company now occupies; and the rival Northwest Company built a post on the same side, about a mile lower down, while the Astor Company occupied a station on the opposite side of the river. In 1821, when the Hudson's Bay and Northwest Companies were united, the

[28]In an application to the Crown Lands Department under date of June 4, 1895, for a grant of land on Pither's point for missionary purposes in behalf of the Indians of Rainy lake and river, Rev. L. P. A. Langevin, Archbishop of St. Boniface, gives the following succinct history of the fort:

"1. In the year of our Lord 1731 the first fort built by white men on the other side of the height of land, near the rapids of Coutchichin, about a mile and a half from Fort Frances, Ontario, was called 'Fort St. Pierre,' in honor of the famous discoverer, Pierre Gaulthier de Varennes, Sieur de la Verendryie.

"2. The builder of the said fort St. Pierre was Mr. de la Jemerays, the nephew of Mr. de la Verendryie, and the brother of the venerable Mere d'Youville, the foundress of the Grey Nuns of Montreal.

"3. The two gentlemen were the ancestors of the late Most Rev. Archbishop Tache, my saintly predecessor, who was very anxious to purchase that historical spot.

"4. I have seen all that appears to remain of that historical old fort—a few stones scattered around the excavations—but the half-breeds say that they have seen wooden buildings there.

"5. The site of the fort is adjacent to an Indian reserve (Coutchichin), where we have a mission and a school."

In the records of his Voyages, made in 1789-93 and written in 1801, Sir Alexander Mackenzie says (p. lvi): "The discharge of this lake [La Pluie or Rainy] is called Lake de la Pluie river, at whose entrance there is a rapid, below which is a fine bay, where there had been an extensive picketted fort and building when possessed by the French ; the site of it is at present a beautiful meadow, surrounded with groves of oaks."

Dr. Bigsby, who arrived at Fort Frances (or Fort Lapluie as it was then called) on 14th July, 1823, on his way to Lake of the Woods, gives the following account of the fort on the American side of the river: "Walking out the morning after our arrival with Mr. W. McGillivray, the Lieut.-Governor, I saw on the opposite side of the river some buildings, and a tall, shabby-looking man, angling near the falls. I asked my companion what all that meant. He replied, 'The two or three houses you see form a fur-trading post of John Jacob Astor, the great merchant of New York. The man is one of his agents. He is fishing for a dinner. If he catch nothing he will not dine. He and his party are contending with us for the Indian trade. We are starving them out, and have nearly succeeded.' The expedients for preventing a rival from entering a rich fur country are sometimes decisive. Every animal is advisedly exterminated, and the district is ruined for years." Shoe and Canoe, vol. II, p. 273.

latter's post was abandoned. As late as 1857, when Prof. Hind conducted his expedition to Red river, the buildings of the Hudson's Bay Co. were surrounded with a stockade; but about twenty-five years ago a fire destroyed the store and warehouses, the only building saved being the factor's dwelling house, then newly constructed. The stockade appears to have been destroyed at the same time.

Many of the prospectors employed in exploring for minerals north and east of Rainy lake make Fort Frances their starting point, and they come back at frequent intervals to replenish their camp supplies. Surveying parties also find it convenient to make the town their headquarters. I met a number of persons of each class, most of whom had come down from the Manitou and Wabigoon districts. Glowing accounts were given of discoveries made there during the past season, and if the properties realize when worked the half of what is claimed for them some fortunes will surely be made. One of these properties is situated north of the Lower Manitou lake, on the east side of Niven's sixth meridian line and near the 41st mile post, being locations HP 304 and 305. Besides gold-bearing quartz veins in the rock, it is claimed that gold in paying quantities is contained in the drift. The placer is a mile in length by three chains in width; pits have been sunk in several places to the rock, which is eight feet below the surface; and it is stated that the gold is well distributed throughout the drift. The discovery was made by three brothers John, August and Eric Fransen and George Aspelund of Rainy Lake City, and is known as the Swede Boys' Claim. They had associated with them last year John Berg, a merchant of Rainy Lake City, who was furnishing the capital, and sluice boxes were sent up to work the placer. Since then a company with headquarters at Kansas city, known as the American Gold Mining Company, has secured the interest of the discoverers in HP 305 along with two adjoining locations, and is preparing to work them. In the prospectus it is stated that three veins have been explored on the locations, one of which has a length of over 3,000 feet and an average width of 7 feet.

Headquarters for prospecting parties

Placer mining.

The Swede Boys' claim.

Mr. McInnes of the Geological Survey, who had been employed during the summer in the district north of Rainy lake, had finished his work there and he came in to Fort Frances a day or two before my arrival. Like myself, he was waiting to take the boat for Rat Portage on Friday morning.

Geological Survey work.

ON RAINY RIVER AND LAKE OF THE WOODS.

Being desirous of getting a better view of the farm lands along Rainy river than the deck of a steamer affords, I left Fort Frances with my son at 2 o'clock Thursday afternoon (Sept. 5) and canoed down about sixteen miles. The current is strong most of the way, and paddling was easy. Nearly every lot along the Ontario side has been taken up, and nearly all were under crop; but in many cases the houses were unoccupied. There were many good fields of crops—spring wheat and oats, but chiefly the latter—showing a vigorous growth of straw, and the heads well loaded with grain. Beans thrive well also, and in the garden plots onions, beets, cabbage, turnips, etc., grow luxuriantly.

Settlement on the Rainy river.

Indian Reserve No. 10.

We called for a few minutes at an Indian encampment on Reserve No. 10, opposite Little Forks river and between the townships of Roddick and Woodyat. It is a small reserve, comparatively, having an area of less than 2,000 acres, and only a few Indians occupy it. The chief of the band, George, was employed with his squaw drawing in and stacking grain, using for the purpose a primitive conveyance of two poles about 15 feet long, like a hand-barrow, upon which the loose grain was piled to the size of a hay-cock. The chief was a tall, well made and handsome looking fellow, with features which a statuary might love to copy. He was a contrast indeed to the other members of the band at the camp, who were common looking and idle fellows, but who possessed one advantage over him in being able to talk a little English.

Social life.

A row boat with sail set had preceded us some distance down the river, carrying six or seven persons picked up at settlers' houses along the way. They were going to a dance at Big Forks, ten or twelve miles down on the American side, given in honor of a family that was moving out. I met them returning at 9.30 next morning, along with another party, and apparently they had had a jolly night of it. All settlers on the river are neighbors if they live within ten miles of each other.

A settler's home.

We put up for the night at the house of Duncan Fraser, who occupies a large farm sixteen or seventeen miles below Fort Frances, in the township of Woodyat. Mr. Fraser and his neighbor Mr. Luttrell had been busy in the harvest field all day; and after supper they too went off to the dance, and did not return until next morning. The farm is finely situated on the river, with gently sloping banks which rise from the water's edge to a height of 25 or 30 feet 75 yards back. A settler who had taken up 700 acres, when the Dominion Government exercised control, sold his interest in it to Mr. Fraser eight years ago, but as yet a patent has only been issued for a homestead of 160 acres. A strong pole fence has been built along the whole front of the farm, leaving an allowance of 66 feet on the river for right of access by boats and right of use for fishery purposes.[29]

Wannigans.

Three large scows covered over with lumber like shanties were beached on the bank in front of Fraser's. They are used by lumbermen when driving logs in spring, and also by the Government road contractors for the cooks, being moved down stream as the work progresses. These scows are known locally as wannigans. In New Brunswick, Mr. McInnes informed me, they are known as wangans, or wangan boats, used by the log drivers for carrying supplies.[30]

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[29] The Crown patent of lots reserves "right of access to the shores of all rivers, streams and lakes for all vessels, boats and persons, together with the right to use so much of the banks thereof not exceeding one chain in depth from the water's edge as may be necessary for fishery purposes."

[30] "Wangan" is defined by the Standard dictionary as a flatboat used by Maine lumbermen for transporting their tools and provisions, and "wannigan" [western United States] as a flat bottomed boat on which a house is built, located on the shore or bank of a river, and intended to float in case of flood or high water. The settlers on Rainy river have adopted the term as used in the western States, while the other term is common to the loggers of New Brunswick and Maine.

We left Fraser's at 8.30 Friday and reached Holmes' dock two miles below at 9 o'clock to await the boat from Fort Frances, which had gone up late the previous night. Mr. Holmes has a small store here, and is building a much larger one with a dwelling house attached. A young farmer alongside of him, who came from Wawanosh township in Huron county, is doing well. He has a number of Indian curiosities, among which is a copper spear-head five inches long and beaten to a point, nearly square in shape and with a half-formed eye to receive the handle. The young man found it in the clay of the river bank, near Holmes' dock. His sister, a bright young woman, told me that their father in Wawanosh has a fine collection of relics.

At Holmes' dock.

Indian curiosities.

A road has been built out from the river at Holmes' dock a distance of four miles, and there are settlers two miles beyond the end of the road. The drain on the roadside has already cut a gorge 15 feet deep and about as wide at its mouth, which extends 60 yards from the river. The cutting shows three different beds of alluvium, all with horizontal lines of bedding. The upper one is about six feet thick, of grayish clay; the middle seven feet thick, of peaty colored clay; and the lower one of layers about one inch in thickness of gray and black, exposed to a depth of two or three feet. The even lines of bedding indicate that the silt was deposited in still water, and not in a running stream.

Character of the alluvium.

I was told by Mr. Luttrell (who was formerly a resident of Wellington county) that the land rises gradually back from the river, and that the muskeg which extends in a long line and a mile in width, parallel with the river, through the townships of McIrvine, Crozier and Devlin, may easily be drained into it. A small lake about 30 acres in extent in the centre of the muskeg depression in Crozier, which has been tapped by a drain, has been lowered several feet already. The level of this lake as taken by Mr. Whitson of the Crown Lands Department was found to be 72 feet higher than the ordinary water level of the river. For long stretches small streams fall into the river at intervals of 100 to 200 yards, giving to the bank a fine flowing outline.

The drainage into Rainy

Settlement on the Ontario side extends all the way from Fort Frances to the mouth of the river, exclusive of the Indian reserves, and everywhere the soil appears to be uniformly good—a finely silted clay and clay loam, holding a great number of limestone pebbles. All the farmers with whom I spoke are delighted with the country and its suitability for settlement. The low land they say can easily be drained, and crops never fail. Clover and timothy yield well, and only in one year have the spring frosts been known to heave the clover; the seed crop of clover also matures well. There are few fruit trees yet, and I learned of only one attempt to plant an orchard. A lot of crab-apple trees were set out by one settler a few years ago, all of which died; but it is stated that they were delivered late in the year and that their roots were frozen before they could be planted.

Suitability of the district for agriculture.

A few settlers are coming in on the Minnesota side, and it is expected that the whole river front will be thrown open this year. Surveying parties and timber agents were busy all last summer getting the territory ready on

The Minnesota side of the river.

behalf of the United States Government, and another Oklahoma rush was confidently expected by the surveyors and agents.[31]

ON BOARD THE EDNA BRYDGES.

Freight and passenger traffic.

The Edna Brydges left Fort Frances at 7 o'clock in the morning, and at 9.30 we got on board of her at Holmes' dock. Towards noon a wind storm came up the river, which increased steadily in force until it became a furious gale. There is a fair amount of traffic on the river; almost every farmer has a dock of his own; and wherever passengers or freight are to be taken on or landed, the boat is accommodating enough to call. But the wind and waves made it a hard task on this trip, and repeated attempts had to be made in many cases before the boat could be brought in to tie up at the dock. It was 8.30 before the mouth of the river was reached, and the wind being too high to venture across the sand bars outside of Oak point, we stayed there for the night. From Fort Frances to the river's mouth the distance according to Hind's measurement is 77 miles 55 chains, and the descent measured from the foot of the falls is 31 feet.[32] The navigation of Rainy river would

[31] The Red Lake Indian reservation in Minnesota extends from the mouth of Black river, one of the tributaries of Rainy river, westward to the western side of Lake of the Woods, and contains what is probably the largest body of virgin pine left standing within the bounds of the United States. A large amount of this forest is included in the part of the reservation to be thrown open for settlement. It will not however be taken up by settlers, but will be sold at auction on the 1st and 15th days of July, 1896. The minimum price of the stumpage is placed at $3 per 1,000 feet.——The reservation was thrown open on 15th May of the present year, (after the text of this Report was in type) and the following account of the rush of settlers is published in Harper's Weekly of June 6: "The reservation has been the home of the Chippewa Indians for centuries. They are a remarkably peaceable and friendly tribe. The portion which was opened May 15 was bought from the Indians under treaty provisions. It is estimated that there are at least eight hundred thousand acres of land which will be found arable. The settlers pay $1.25 per acre for it, with incidental registration fees amounting to about fifteen dollars, and have five years in which to pay for the land. As early in the year as late February and early March prospective settlers from surrounding States began their long overland journeying to the region. The winter was favorable to such migration; but about the 1st of April heavy rains set in, discouraging many settlers, and causing many to return to their homes. As the date of opening approached however there were a good many thousands of settlers in the region. Some of them staid conscientiously at the line over which they were not to pass until the stroke of nine on the morning of the 15th; others waited at the land office at the town of Crookston, preferring to make filings upon the land they wanted before going upon it, believing that priority of filing would beat priority of location when it came to a contest; while many others, and by far the larger number, if one is to judge by personal investigation as well as by report, did not wait for any opening gun to be fired on opening day, but calmly moved upon the reservation many hours before the opening time, and located themselves on the land of their choice. Of course this was all contrary to law and to the special telegraphic instructions of Commissioner Lamoreau that no settlers be allowed on the reservation before the hour of opening. It would have been practically impossible to prevent the settlers however from entering upon the reservation, as it would have required a military force large enough to patrol a line at least 300 miles long to keep them from making entrance. So there was no obstacle whatever placed in the way of the settlers, and many of them entered the lands long in advance. Of course, when it comes to filing at the land office, it may transpire that these settlers have forfeited their rights by thus going upon the land in advance, but it will be difficult in many cases to establish evidence against them. At Crookston, the nearest land office, and the point where all filings must be made, the line of filers began to form four days before the time of legal entry. Quite a number of fellows, who only cared to sell out their place on the day of opening, or who were trying to file upon good pieces of land merely for the sake of selling out to some gullible home-seeker, remained at the head of the line ninety-six hours. By far the greater number of those who were desirous of effecting entrance on the reservation were thrifty young fellows—Americans, Norwegians and Swedes predominating—who had come for the purpose of making homes in the new land."

[32] The length of Rainy river from Fort Frances is taken from the table in Appendix I., vol. II., pp. 399-402 of Hind's Narrative, and the total length by the same authority is 79 miles, 55 chains. But as measured on the MS. map in the Crown Lands Department, prepared from notes of surveys of townships and Indian reserves, the actual length is 86 miles. From Pither's point, where the river flows out of Rainy lake, its course is a point south of west, 5½ miles in front of McIrvine township to near the west line of section 13 in Crozier.

be greatly improved if the rocks in the Manitou and Long rapids were blasted out, and owing to low water last year several accidents occurred in these parts of the channel.

The boat left for Rat Portage at the foot of Lake of the Woods at 6 o'clock Saturday morning, with the wind still high, and she experienced rough weather in crossing the grand traverse of 30 miles to the shelter of the islands. We took up a party of excursionists from a fishing boat in a bay upon the east side of the lake, near to one of the numerous sand banks there; and the water being only six or seven feet deep, with the waves rolling high, the keel of the Edna Brydges bumped over and over again upon the sand bottom. But as long as there were no rocks, there was no danger.

Grand traverse of Lake of the Woods.

Fishing is now a very important industry in Lake of the Woods. There are stations on all the principal bays, and a number of tugs are employed to make regular rounds and convey the catch to Rat Portage, where shipments are made to Winnipeg, St. Paul, Minneapolis and other markets throughout the Northwest. The sturgeon and whitefish of Lake of the Woods are of excellent quality; but at the rate at which operations have been carried on during the last two years it is feared that the waters will soon be fished out. The roe of sturgeon is shipped in large quantities to Europe, where it is manufactured into caviar.

The fisheries of the lake.

The northern half of Lake of the Woods is an archipelago, and a sail through its hundreds of islands is most delightful at any time during the season of navigation, but especially in the early days of September, when the trees begin to present the rich and varied tints of their ripening foliage. Fifty years ago (10th September, 1845) Ballantyne crossed this lake by canoe from Rat Portage to the mouth of Rainy lake, and he has left a glowing

Through the archipelago.

It then flows south on the east side of Crozier and Roddick about 3½ miles, when it bends around to the west and flows in that direction 17 miles along the townships of Roddick, Woodyat and Aylsworth, to the line between sections 22 and 21 in the last named. Indian Reserve 10, having a width of a mile and a half, lies between Roddick and Woodyat. Lavallee river comes down from the north, through the townships of Devlin and Woodyat; while from the Minnesota side there join the larger tributaries of Little Forks opposite the Indian reserve, Big Forks opposite the line between Woodyat and Aylsworth, and Black river opposite section 21 in Aylsworth. Here it turns northwest 2 miles and then north 7½ on the west of Aylsworth and Lash to the line between the latter township and Barwick. Again it flows west 19 miles in front of Barwick (which is divided by Indian Reserve 11), Roseberry, Indian Reserves 12 and 13 and Morley. Manitou rapid and its one Indian mound occurs about midway across Reserve 11, and the Long Sault rapids in front of Reserves 12 and 13, where there are two large mounds. Sturgeon river comes in from the north, through Dobie and Shenston and the southeastern corner of Reserve 12. At the southwestern corner of Morley, opposite section 6, the river bends northwest and continues in that direction 5½ miles to the mouth of Pine river in Dilke. For the next 5 miles it flows nearly west, to section 26 in Worthington, and southwest a mile to section 22 in that township, opposite the mouth of Muttontina river on the Minnesota side. It then flows west 4 miles along the front of Worthington to section 25 in Atwood, where is the extensive booming ground of the lumbering companies. At the mouth of Beaudet river on the Minnesota side the trend of the river is northwest 9½ miles, by Atwood township, the wild lands reserve and half-way across Indian Reserve 37; and thence northward 6½ miles by Reserves 37, 14 and 15 and part of Spohn township, to its mouth in Lake of the Woods. In this long course the river lies south of the latitude of its head at Rainy lake (48° 37′) for a distance of 33 miles to Emo P. O. in Lash; the greatest point of deflection being in Woodyat, in latitude 48° 32′. For the rest of its length, 53 miles, it lies north of this line, the farthest point being the river's mouth, 48° 53′. In the latitudes here given I follow Thompson's survey map of the Boundary Commission, 1826. From Rainy lake to Lake of the Woods tracts of land aggregating 54,565 acres have been set apart along the river for Indian reserves. They are made up as follows: No. 18, on Rainy lake, 4,586 acres; No. 1 and No. 16, adjoining Fort Frances on the east, 170 and 160 acres respectively; No. 10, 1,920 acres; No. 11, 5,673 acres; No. 12, 5,047 acres; No. 13, 6,367 acres; No. 37 (Powawason), 3,687 acres; No. 14 (The Bishop), 3,983 acres; No. 15 (Paskon), 2,301 acres; and an unappropriated wild land reserve of 20,671 acres.

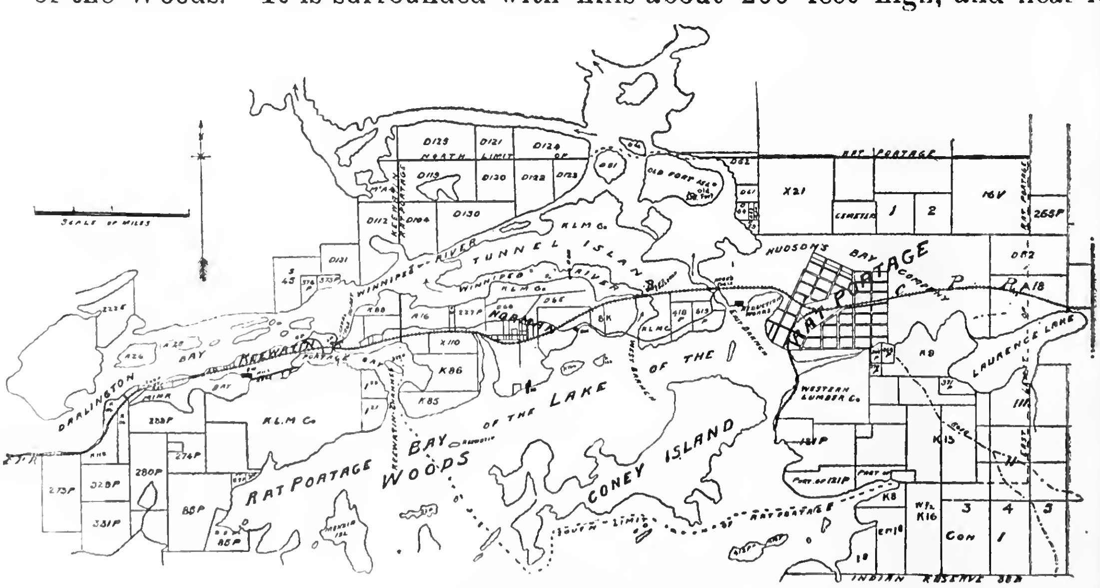
Ballantyne's pen picture.

description of the impression which the voyage gave him. "There is nothing, I think, better calculated to awaken the more solemn feelings of our nature (unless indeed it be the thrilling tones of sacred music) than these noble lakes, studded with innumerable islets, suddenly bursting on the traveller's view as he emerges from the sombre forest rivers of the American wilderness. The clear unruffled water, stretching out to the horizon—here embracing the heavy and luxuriant foliage of a hundred wooded isles, or reflecting the wood-clad mountains on its margin, clothed in all the variegated hues of autumn; and there glittering with dazzling brilliancy in the bright rays of the evening sun, or rippling among the reeds and rushes of some shallow bay, where hundreds of wild fowl chatter as they feed, with varied cry, rendering more apparent rather than disturbing the solemn stillness of the scene: all tends to 'raise the soul from nature up to nature's God,' and reminds one of the beautiful passage of Scripture, 'O Lord, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.'"[33] Mr. Ballantyne made the trip from the lower to the upper end of the lake with a north canoe and eight men to paddle it in a day, which was fast time. The steamer Edna Bridges made it from the upper to the lower end in nine and a half hours of very stormy weather. The distance is 72 miles.

Lake of the Woods Gold Region.

Rat Portage and its early history.

"The Fort in the occupation of the Honourable Hudson's Bay Company at Rat Portage is beautifully situated on an island at one outlet of the Lake of the Woods. It is surrounded with hills about 200 feet high, and near it



Map of Rat Portage and Keewatin.

some tall white and red pine, the remains of an ancient forest, are standing amidst a vigorous second growth."[34] So wrote Henry Y. Hind in his Narrative of the Red River Expedition of 1857. There are three outlets from the lake, which unite below to form the Winnipeg river—one near the west side, a small stream now called Keewatin channel, where Keewatin village stands;

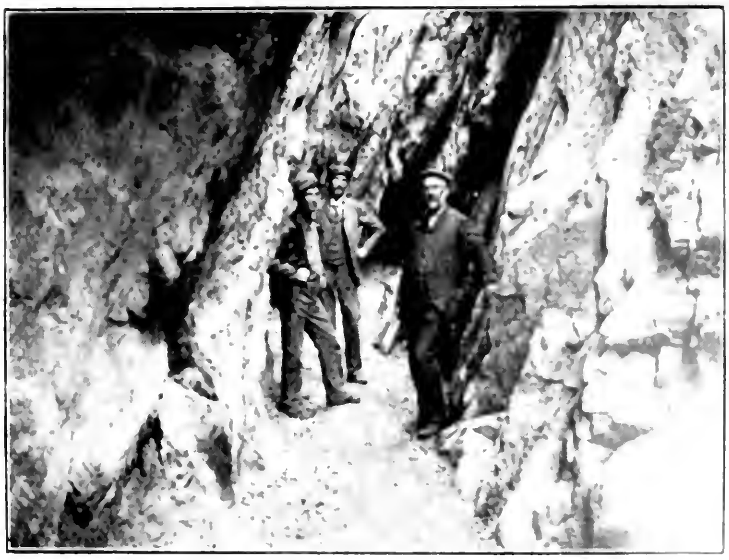
[33] R. M. Ballantyne's Hudson's Bay, pp 271-2.

[34] Vol. I, page 107. "We arrived at Rat Portage, where the Great Winnipeg issues from the Lake of the Woods, on the morning of the 27th of August" p. 105.

Rat Portage in 18[illegible]1, p. 170. Reproduced from a sketch by Dr. Bigsby.

Hudson's Bay Co. Fort at Rat Portage, on Old Fort island, 1857, pp. 168 and 171. Reproduced from a sketch by H. Y. Hind.

Sultana bay, north side of Sultana island, p. 177. From a photograph by Miss Alice M. D. Fitch.



Crown Reef vein, Sultana Mine, p. 179. From a photograph by Miss Alice M. D. Fitch.

Gold Hill Mine and Mill, p. 172. From a photograph by Dr. George M. Dawson.

one near the east side of the lake, close to the modern town of Rat Portage, called the east branch of the river, on which is the beautiful Hebe's falls; and the third and largest in the middle, called the west branch, on which is the Witch's cauldron, and the great dam recently completed by the Keewatin Power Company. The village of Norman, built on the island between the middle and western outlets, is now part of Rat Portage town, having been incorporated with it in 1892, but Keewatin has maintained an independent existence. On the old maps Portage du Rat is shown to be near the western channel.[35] Upon the left bank of the middle channel there is to be seen an old trail, now grown up with bushes; but the portage at present in use by the Indians is on the right bank of the eastern channel. Such however is the march of progress in our time that the oldest inhabitants do not appear to know where the original Rat Portage or the Hudson's Bay Co. post of that name stood. They will guess that it was here or there, and no one cares where.

The locations of Portage du Rat and the old H. B. post.

In Captain Palliser's Journals there is this entry under date of Saturday, July 4, 1857: "On coming to that portion of our route known as the Portage des Bois we found the lake waters so much above their usual level that we were able to sail right over it. We now continued threading our way among wooded islands during the remainder of the day, and at 5 p m. reached the Rat Portage at the head of Winnipeg river. The fall at the Rat Portage is only one of several outlets by which the waters of the Lake of the Woods escape, afterwards to unite in forming the larger river we were about to descend. The fall is of considerable height, and enclosed between high perpendicular walls of rock, and at a distance of four or five hundred yards further on the waters mingle with those of another stream, which, although of great width, we were surprised to find was spanned by a wooden bridge. The scenery here is very wild, having all the requisites for grandeur, such as dashing waters, rugged precipices, and variegated foliage. On the left bank of the river, opposite to where the portage path terminates, there is a small temporary trading post of the Hudson's Bay Company. We did not land at this place, but we obtained from the person in charge a small supply of sturgeon and whitefish.[36]"

Various opinions.

Captain John Palliser.

From Dr. Robert Bell of the Geological Survey I have received the following information: "I was at Rat Portage in 1872. The H. B. Co's. post was all that there was of it then. It consisted of two one-story log shanties—a sale shop and a dwelling. They stood on the west side of what afterwards

Dr. Robert Bell.

[35] It was at the head of Portage bay, now called Keewatin bay, and as nearly as may be along the line of the mill race of Dick, Banning & Co's. mill. On Thompson's map, 1826, it is called Portage de Rat. Yet in his MS. Journal under date of July 27, 1798, Mr. Thompson makes this entry: "N.B. The Rat Portage is on an island. A bold branch must certainly come down on the westward of the Rat Portage from the strong deep current we go down with till we meet with the main branch, which has its fall exactly opposite the island and comes out about one-half mile or one mile below it." In his record of observations for July 19, 1823, the portage is described as the "Muskrat Carrying Place." In Sir Alexander Mackenzie's Voyages, p. lix., that writer says: "The carrying place out of the lake is on an island, and named Portage du Rat, in latitude 49.37 north and longitude 94¼ west, it is about fifty paces long. The lake discharges itself at both ends of this island and forms the river Winnipic," etc. Neither of these passages is very intelligible if the eastern channel be meant, as the portage there is along the right bank and upon the mainland.

[36] Journals, Reports and Observations relative to the Exploration of British North America by Captain Palliser, p. 34.

became the first and main street of Rat Portage. The shanties were at the same spot till 1882, when they were burnt and the company moved across the street and a little further south. By 1881 they had been replaced by clapboarded buildings, or the log ones had been clapboarded and built higher. . . My visit in 1872 was made when I came up the Winnipeg river and passed into the Northwest Angle The place was then a little outpost of the Company, with a small stock of goods for the Indian trade. The only clearing was the little space between the canoe landing and the shanties. All around was unbroken forest. . . In 1826 there might have been a post at the western outlet, but I never heard so."

Alexander Matheson of the H. B. Co.

Alexander Matheson, factor of the Company at Red Rock, Nipigon, who has been a long time in its service is able to give more definite information concerning the portage and the post. "The old post," Mr. M. writes me, "was situated on an island a short distance below the falls of the eastern outlet of Lake of the Woods, and relics in the shape of parts of clay chimneys, etc., were to be seen there a few years ago. The Portage du Rat proper is west of the western outlet, at the place where Dick, Banning & Co's. sawmill is. The site of the old post is now known as Miller's island, and is nearly opposite the Rat Portage electric works."

Dr. John J. Bigsby.

For more precise and definite information concerning the Rat Portage however, it is necessary to go back of men now living. Richardson, Ballantyne, Thompson, Mackenzie and others have left records of travels from the river St. Lawrence and the great lakes to the Northwest; but the only minute reference to Rat Portage that I have come across is made by Dr. John J. Bigsby, who made a tour of Lake of the Woods in 1823 as secretary to the Boundary Commission under articles VI. and VII. of the Treaty of Ghent. "We encamped on the 18th of July," Dr. B. records, "on an islet near the mouth of the river La Platte, from fourteen to sixteen miles southwest of the Rat Portage. It comes from a very large and shallow lake of the same name.[37] . . . Towards the Rat Portage the country rises, and the scene becomes precisely that of the Thousand Isles on the St. Lawrence below Kingston, so exquisitely beautiful when seen on a calm evening when the shadows are long. We have the same low cliffs and morsels of rock, the same pines and birch in artistic groupings, the same deep and transparent waters. In one place, while our canoe was moving through the water rapidly, it received a sudden and startling shock. We had struck upon a sleeping sturgeon, which we traced in the troubled waters, making off with all speed. The Rat Portage, in north latitude 49° 46′ 22″ and west longitude 94° 39′, which leads from the Lake of the Woods into the Winnepeg river, its outlet, we reach by a narrow cul-de-sac, 600 yards long, ending in a grassy swamp, the portage lying between two eminences, naked but for burnt pines, a few cypress trees and poplars. This cul-de-sac is 120 yards broad at the portage, and is made offensive and foul by dead insects, the croaking of frogs, and the plague of mosquitoes. The hill east of the cul-de-sac, 200 feet high, gives an excellent idea of the envir-

[37] This water appears to be what is now called Shoal lake, which discharges into Lake of the Woods by the Shoal Lake Narrows. On the Geological Survey map it is also called Lac Plat, and on other maps its outlet is called La Platte river.

ons. It embraces the Lake of the Woods and the waters of the Winnepeg. We see from hence that the Portage is a neck of land fifty paces across, between the dirty cove in the lake and a magnificent sheet of water formed by the junction of the Winnepeg with a large river, whose name I could not learn, coming from the west; [38] and the united stream flowing down a prolonged woody valley. Wild islands of granite stud the west side of this basin, whose shores are high and naked, and backed by three ranges of lofty hills, either bare or covered with bright young verdure." [39]

On the maps of the Crown Lands Department only two outlets of the lake are shown, viz., the East Branch of Winnipeg river, east of Tunnel island, and the West Branch of it, west of that island. There is however another outlet, shown on some maps as Keewatin channel, through which in time of high water Portage bay overflowed into Mink bay, the latter being connected with Darlington bay at the railway crossing. This channel has been deepened to form a mill race for the Keewatin Lumber Company's saw-mill, and the fall of water is 18 or 20 feet.

As to the location of the old H. B. post, Mr. Ap'John, Master of Titles at Rat Portage, gives confirmatory evidence of Mr. Matheson's statement. He writes: "I have interviewed Mr. Pither, who has acted as Indian agent at various points in the district, and he tells me that 'the Hudson's Bay post in 1846 was on an island below the falls, where the electric light power house now is,' that is, the eastern opening to the Winnipeg river." In the records of his office Mr. Ap'John finds that the island was granted as a mining location to one George Miller; hence the name of Miller's island, but on the maps of the Department of Crown Lands it is called Old Fort island.

R. J. K. Pither.

It seems to be made clear by the foregoing that the name of Rat Portage (Portage du Rat) was given originally to the carrying place across the island from Portage bay into Darlington bay, near the limits of the present village of Keewatin, and that the site of the old H. B. post of Rat Portage was on Old Fort island. The town as incorporated by an Act of the Legislature in 1892 embraces an extensive area of land and water, as shown by the sketch map on p. 168.[40]

In 1885, when the first municipal census of Rat Portage was taken, it had a population of 870. In 1895 it had 2,965; and Keewatin, which did not have corporate existence ten years ago, had last year a population of 618. This prosperity is due in part to the construction of the Canadian Pacific Railway, which was opened through from Fort William on lake Superior to Winnipeg in 1883, and whose first train from Montreal to Vancouver passed

[38] Dr. Bigsby was in error in assuming this water to be a river. It is now known as Darlington bay, and receives from the west the overflow of a number of small lakes on both sides of the line of the Canadian Pacific Railway.

[39] The Shoe and Canoe, or Pictures of Travel in the Canadas, by John J. Bigsby, M.D., vol. II, pp. 302-4. Dr. Bigsby's memoirs were not written until 1850.

[40] By correspondence with Mr. Matheson and Mr. Ap'John I have succeeded in getting definite information regarding the old post, which has been laid down upon a sketch map by Mr. Pither. "The post was removed to the mainland in the summer of 1861," Mr. P. states, "and the buildings were put up near where the H. B. Co.'s store now stands on Main street. The reason for removing the post was the difficulty during the winter in crossing from the island to the mainland, as the ice was always dangerous owing to the strong current. The first time I passed was in the month of June, 1846, on my way from Lachine to York Factory, in the service of the H. B. Co."

The modern Rat Portage.

through Winnipeg on Dominion Day, 1886. The railway gave easy access to the prairie settlements of the Northwest, whose greatest want was lumber. Mills were built at Rat Portage, at Norman and at Keewatin to supply this market, and although the business has been overdone at times it has been on the whole steady and prosperous, and has given employment to large numbers of workmen at the mills, in the pine woods, and upon the rivers, bays and lakes where rafts of logs are driven or drawn ; for all the timber on Lake of the Woods and its extensive tributary waters is cut at the Rat Portage and Keewatin mills. A third source of the prosperity of Rat Portage is the mining industry, although hitherto its progress has been slow. Canadians take kindly to lumbering ; they have had a long experience of it, the value of a pine forest is easily estimated, and there is not much risk in an investment for one who knows how to make it. But with mining it is otherwise. Few men in Ontario understand it, or have had experience of it ; and unlike the raw material of the lumbermen, the raw material of the miner is underground and must be explored at heavy cost. The business requires capital and skill, and if these are supplied the risks are perhaps no greater than in any other line ; yet in by far too many cases with us it has been undertaken without adequate capital or skill, and the record of failures has been disheartening, although perhaps not any more so than in many other countries where mining has been successfully carried on. It is certain that in the Lake of the Woods region experience has shown the folly of attempting to work a gold mine without means or requisite knowledge ; and the outlook is more promising now than ever before. All gold veins are not likely to yield the metal in paying quantities ; if one in five or even one in ten do so, the field may prove to be as rich and attractive as gold fields elsewhere of established reputation. And a ten-stamp gold mill working the year round may do as much for the prosperity of a town like Rat Portage as one of its largest saw mills. The latter may overstock the market with lumber, as indeed they have been doing within the last two years ; but a hundred mills placed on Lake of the Woods to treat ore, if they produced gold bricks every week with the regularity of the Sultana mill, would not glut the gold market nor weaken the price of the metal by the weight of a hair.

Sources of its prosperity.

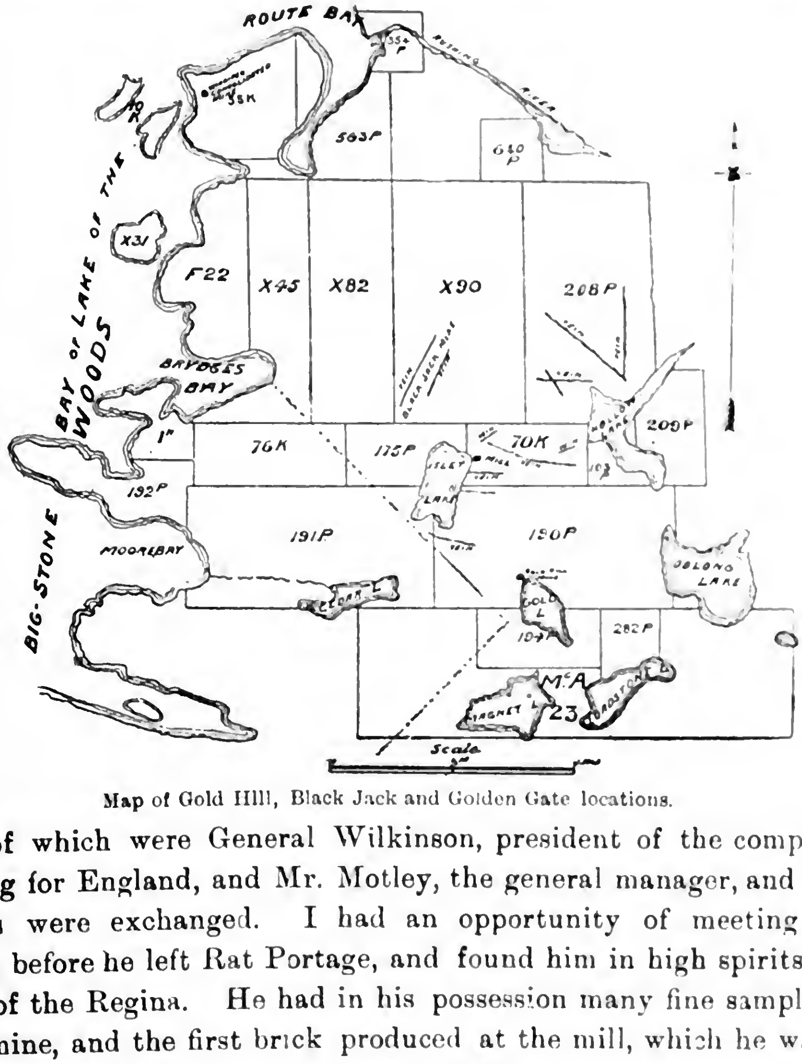
THE GOLD HILL LOCATIONS.

The Director of the Geological Survey.

Dr. George M. Dawson, Director of the Geological Survey, arrived by the Sunday evening train from the west, and stayed over at Rat Portage for a day. He had been up at Athabasca Landing, north of Edmonton, in Alberta Territory, inspecting the boring operations there in prospecting for petroleum. We arranged to visit the Gold Hill locations together on Monday, September 9th. Mr. Robert H. Ahn, manager of the Dominion Gold Mining and Reduction Works Co., was going out with his tug and a scow load of supplies for the camp at Gold Hill, and he kindly offered us a passage. It was 10.45 before the little tug could leave its dock, and with a head wind against us it was one o'clock in the afternoon before we reached the company's new dock in Brydges bay. The route lies south through the Devil's gap (which Dr. Dawson remarked should be called by the more appropriate name of Gabriel's

gate, for its singular beauty), and thence southeast by Bare point and Quarry island, and between Heenan point and Needle point across Big Stone bay. Instead of continuing on through Eagle Pass to the old landing in Moore bay, we entered a small bay about a mile to the north of it known as Brydges bay, where a new dock has been built, and from which a good road has been cut in to the Black Jack mine. It is a very good road, saving for one steep hill, which on its western slope is covered with Laurentian boulders. The distance from Rat Portage is in a straight line twelve miles, but by water it is about fourteen miles. Near Bare point we met the Regina Company's steam launch,

From Rat Portage through the Devil's gap to Brydges bay.



Map of Gold Hill, Black Jack and Golden Gate locations.

on board of which were General Wilkinson, president of the company, who was leaving for England, and Mr. Motley, the general manager, and the usual salutations were exchanged. I had an opportunity of meeting General Wilkinson before he left Rat Portage, and found him in high spirits over the prospects of the Regina. He had in his possession many fine samples of ore from the mine, and the first brick produced at the mill, which he was taking with him to exhibit to the shareholders in England.

General Wilkinson of the Regina mine.

The Dominion Gold Mining and Reduction Company, Limited, has been organized under the Companies' Acts of Great Britain, 1862 to 1890, with head offices in London, Eng., and among the objects for which it has been established are the following: "To prospect, search for, get, win, work and raise gold, silver, coal, iron, ironstone and other ores, metals, minerals and substances whatsoever, whether by open or underground workings, and to carry on the business of miners, millers, smelters and workers of any processes in the production, reduction and making merchantable of ores, minerals, metals and metallic products, supplies of water, merchants and manufacturers and

The Dominion Gold Company,

and its objects.

workers of any minerals, metals, articles and things used in or in connection with mining, milling, smelting and other processes aforesaid, or any of them."

The authorized capital is £170,000, in shares of £1 each, whereof it is stated £20,000 has been subscribed and paid up for working capital. The board is composed of Somerset F. Gough-Calthorpe, chairman, Edmund A. Robinson and Hon. Mountstuart W. Elphinstone, and among the other shareholders are Lord Elphinstone, Alexander M. Hay, James E. Hope, G. Dunlop and Hon. Edward B. Elphinstone. F. W. Croucher, of London, is secretary of the company, and Robert H. Ahn, of Rat Portage, is resident manager.

Properties of the company.

The company was incorporated 23rd August, 1895, and immediately afterwards it acquired by purchase the properties of the Gold Hill and Black Jack mining companies, which were sold by order of the court. The locations acquired comprise 70K, 76K, 175P, 190P, 191P, 193P, 194P and 282P of the old Gold Hill Company; 90X, 192P and 11I in the locality of the Black Jack Company; and in addition a location on Yellow Girl bay known as the Homestake, Sultana Junior opposite Sultana island, a third interest in the Queen of Sheba location on Ptarmigan bay, and 101K in Jaffray township, all of which had been held by the Black Jack Company; besides the Elphinstone property on Shoal lake Narrows, and the Rat Portage Reduction Works.

Operations on location 70K.

At the date of my visit work was carried on chiefly upon location 70K, where the Northern Gold Company had erected a mill and done some mining work in 1893. Three shafts were being sunk on what is known as the Pebble vein, which lies in a formation of hornblende schist with a north and south strike, and cuts it in a course 70° east of north. The first and third shafts are on the crown of nearly parallel ridges of schist, about 220 yards distant from each other, and the second is on the slope of the western ridge. Between the second and third is a narrow muskeg valley, which is crossed by a tramway constructed by the Northern Company to convey ore from an open cut commenced near No. 2 shaft. No. 1 shaft is close to the northwest corner of the location, and the vein is traceable beyond it down into low ground on the Black Jack location. This shaft is 6 by 9 feet, and is being sunk with the object of affording ventilation for No. 2, which is distant from it 325 feet. The vein is well exposed by cross cuttings for this length, and No. 2 shaft, 6 by 9 feet, has been sunk to a depth of 66 feet. At the bottom a drift has been commenced, extending east 8 feet and west 14 feet. At the top of the shaft the quartz is nearly the full width of the vein, and while it narrows downward it shows a well defined foot wall, dipping south 75°. At the end of the west drift the width was 3 feet, and at the end of the east drift it was only 15 inches. The air in this shaft was impure, but means were being taken to supply fresh air through a tube of 6 inches diameter, the lower section of which was of canvas with wire coils inserted to keep it distended—to be drawn out of the way whenever blasts are fired. Through this tube fresh air will be forced down by a fan. This arrangement however is only temporary, for when No. 1 shaft is sunk to a depth of 100 feet and the intervening section of the vein is stoped out, good ventilation will doubtless be secured. A derrick was in course of erection over No. 2 shaft for hoisting purposes. No.

3 shaft is 336 feet east of No. 2, and was sunk to a depth of 22 feet. The size was 7 feet 4 inches by 11 feet, but as this is intended to be the main working shaft as soon as a drift has been extended from No. 2 to No. 3, the contract calls for a size of 11 by 13 feet. The dip is 76° south, or nearly the same as at No. 2. Work has also been commenced upon a small vein called the Jewel, south of the mill, where it crops out upon the east shore of Islet lake. An open cut has been made on the vein for a length of 20 feet, and to a depth of 15 feet at the eastern end. The vein is only a few inches wide at the surface, but at 10 feet it measures 12 to 15 inches; and, like the Pebble, its dip is towards the south. It is said to yield rich ore, and a panning from the dirt at the dump showed gold colors.

The mill erected by the Northern Gold Company was in course of reconstruction, and some of the old plant was being torn out. The old company had re-equipped it in 1893 as a Colorado mill with two batteries of five stamps each, having a drop of 18 inches. It was also supplied with a Forrester ore breaker, a pair of Cook amalgamators, and a boiler and engine of 45 h. p. The new company proposes to retain the Colorado mill, and to add two Perfection concentrating tables from the Colorado Iron Works of Denver. Two Tulloch feeders are also to be provided for the batteries, and the Cook amalgamators will be retained to treat the tailings after they have passed over the concentrators. It is also intended to supply a boiler and two engines to work the hoisting drums between the No. 2 and No. 3 shafts. The gold mill.

A diamond drill has been purchased from the American Rock Drill Company, to be used in exploration work, and an electric plant will be placed in one of the buildings of the Black Jack property to supply light for the shafts and mill. The machinery

The buildings of the Gold Hill location consist of the mill, office, dining camp, four sleeping camps, dry room, forge and stable. On the Black Jack are a shaft house, mill, engine and boiler house (which will be supplied with a hoisting engine and electric plant), a large boarding house and dining camp. The main shaft on this location is said to be 80 feet deep, but it was full of water. At the time of my visit in 1893 (17th August), it had reached a depth of 63 feet. Several other openings have been made, including a shaft on what is known as the Bull Dog—a strong vein showing good ore. and buildings.

The following entry made in the Inspector's Book under date of August 9th supplies fuller particulars of the mines and works:

"To-day I visited the properties of the Dominion Gold Mining and Reduction Company of London, Eng., known as the Gold Hill and Black Jack mines, southeast of Big Stone bay in Lake of the Woods. Entry in Inspector's Book.

"Mr. R. H. Ahn is in charge as superintendent, and Joseph Hicks as mining captain

"The properties of the company consist of locations 70K, 76K, 175P, 190P, 191P, 193P, 194P and 282P of the Gold Hill, and 90X, 192P and 11I of the Black Jack, besides locations in other parts of Lake of the Woods region. A dock has been built on Brydges bay where boats land,

and a good road has been cut out up to the Black Jack mine, by which access is now gained to the locations from the lake instead of over the old road from the head of Moore bay.

" Work at present is carried on chiefly upon location 70K, where the former owners, the Northern Gold Company, had erected a stamp mill and done some mining work.

" Mining operations are confined to a vein known as the Pebble, which cuts the formation in a course 70° east of north, the strike of the formation being nearly north and south.

" Three shafts are in course of being sunk, the first and third on nearly parallel ridges about 220 yards distant from each other, and the second upon the eastern slope of the west ridge. Between the second and third shafts is a narrow muskeg valley, crossed by a tramway for conveying ore.

Extent of the workings.

" No 1 shaft is near the northwest corner of the location, and is intended to provide ventilation for No. 2. It is 6 by 9 feet, 14 feet deep, and is timbered to solid rock.

" No. 2 shaft is 325 feet east of No. 1. It is 6 by 9 feet, timbered to solid formation, and sunk to a depth of 66 feet. At the bottom drifting has been commenced each way along the vein, the length west being 14 feet and east 8 feet. At the top of the shaft quartz is nearly the full width of the vein; at the west end of the drift it is 3 feet wide, and at the east end about 15 inches. The foot wall is well defined, and dips towards the south at an angle of 75°. The air at the bottom of the shaft is impure, and it is proposed to supply fresh air by means of a fan until ventilation is obtained by connection with the No. 1 shaft. A derrick is in course of erection over the shaft for hoisting purposes.

" No. 3 shaft is 336 feet east of No. 2. Its depth is 22 feet, and the present size 7 by 11 feet, the dip being south at an angle of 76°. There is a showing of quartz four inches wide on the foot wall. This is intended to be the main working shaft of the Pebble vein when the level is driven from No. 2 to No. 3 shaft.

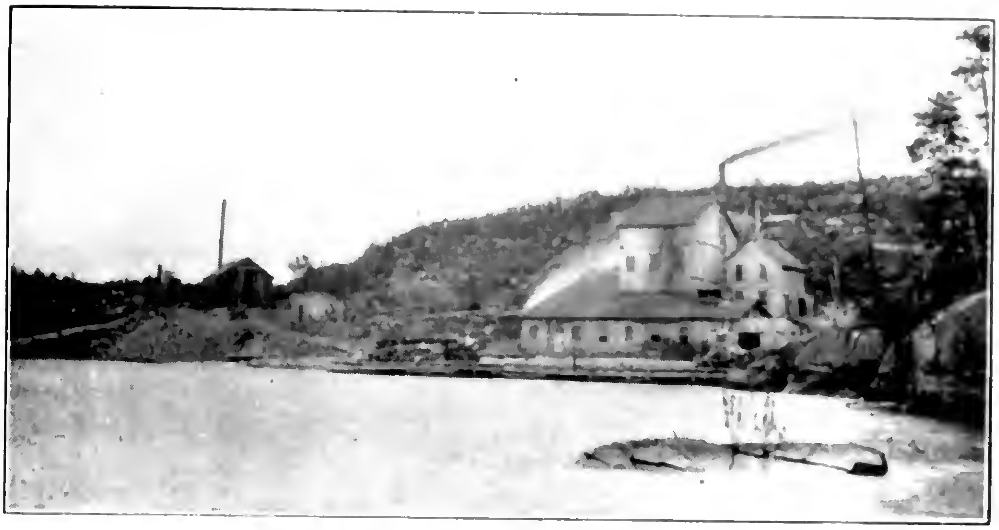
" The work of sinking these shafts is carried on by contract.

" Work has also been commenced upon a small vein south of the mill, on the east shore of Islet lake, and known as the Jewel vein. An open cut has been made on the vein for a length of 20 feet, the depth of which at the eastern end is 15 feet. The outcropping of quartz at the surface is only a few inches wide, but at 10 feet depth it increases to 12 inches, with a dip to the south. Pannings made from dirt of the dump heap give good showings of free gold.

" In the northern part of the location a number of pits and one shaft were sunk by the former owners, but their depth has not been measured.

Outfit of the mill.

" The mill is in course of reconstruction. There are two batteries of five stamps each, with a drop of 18 inches, a Forrester ore breaker, a pair of Cook amalgamators, and a boiler and engine of 45 h. p. The company is adding two Tulloch feeders to the batteries, and two Improved Perfection concentrating tables made by the Colorado Iron Works of Denver, their purpose being to complete the mill as far as practicable on the Colorado pattern.



Sultana Mine in 1895 p. 177. From a photograph by Dr. George M. Dawson.

Sultana Mine in 1896, showing the new camp and the chlorination works to the left p. 177

Regina Gold Mine and Stamp Mill, p. 182.

View across Regina bay, looking northeast from the Regina Mill, p. 187

"The other buildings on the Gold Hill location are dining camp, four sleeping camps, dressing room, office, blacksmith's shop and stable; and on the Black Jack location shaft house, engine and boiler house, and dining and sleeping camps.

"A shaft was sunk on the Black Jack location by the former owners to a depth, it is stated by the superintendent, of 80 feet; but it is at present nearly filled with water. Several other openings were also made, but none are in a condition to be examined.

"It is directed that the mouth of every shaft and pit not now in use upon both properties shall be securely fenced, as required by Rule 6 of the General Rules of The Mines Act 1892 (section 74), and also that the attention of contractors be called to the provision of section 9 of the Act relating to Mines and Mining, statutes of 1894. Directions.

"Two copies of the mining laws of the Province are presented herewith, one for the superintendent of the works and one for the mine captain; and special attention is called to the provisions of Part IV of the Act of 1892 (sections 53 to 76 inclusive), and to section 9 of the Act of 1894.

"Fifty men are employed by the company, of whom thirty are miners working by day and night shifts of ten hours. The others are laborers, carpenters and machinists." Employes.

Location 208P, which adjoins 70K on the north, has been prospected by Mr. Ahn under an option from the owners since my visit to the locality, and the showings are reported to be so satisfactory that it is likely to be taken over and worked in the spring. A new prospect.

Instead of returning to the dock at Brydges bay in the evening we walked through the Black Jack, 90X, north to the old Winnipeg Consolidated mine, on the southeast shore of Big Stone bay, where we got on board the boat and returned to Rat Portage late in the evening

THE SULTANA MINE.

Tuesday and Wednesday were spent at the Sultana gold mine, the first day in the company of Dr. Dawson. Very gratifying progress has been made on this property since my former visit in 1893; a large body of ore has been expossd by shaft, winze and drifts, and the mill is a steady gold producer. The following entry in the Inspector's book under date of September 11 gives details of the mine and works: Progress of operations at the Sultana mine.

"I have to-day visited the Sultana mine on behalf of the Inspector, and have carefully examined the condition of the mill and underground workings as regards the health and safety of employés. Entry in the Inspector's book.

"The plant of the mill is the same as at the previous inspection. The ore crusher is undergoing repairs, but all other machinery, including batteries, vanners, power and electric engines, steam pumps, etc., are in use, in good condition, and as far as I can observe are satisfactorily guarded at every point to prevent the occurrence of accident to the workmen. Plant of the mill

"In the shaft house are a steam boiler of 45 h. p., a Rand air compressor of 12 by 18 inches which drives three Little Giant drills in the mine, and a and shaft house.

hoisting engine of 15 h. p., all in good running order, and with their pa properly safe-guarded. The room is neat and clean.

The working shaft.

"The working shaft of the mine is situated a few feet south of the sha house, and separate from it. The openings to the skip-road and man-road a enclosed with substantial iron pipe railing, with movable gates, and a boa partition separates the two roads down to a point nearly midway between t second and third levels, with timber cross-pieces at intervals securely set a ironed into the foot and hanging walls.

"In the man-road are twelve platforms or landings between the top a bottom of the shaft, the distance between each being about fifteen feet, a the ladders are constructed of good material, well put together, and fasten firmly in place.

"The skip-road is built with double timbers resting upon the foot wa on which the ore skips ascend and descend, being hoisted and lowered by wi rope attached to the drum of the hoisting engine and passing over a groov wheel supported by a derrick that surmounts the shaft. The skips are ru according to the usual signals, a copy of which is posted in the shaft house f the instruction of engine-men and miners. Heavy trap doors are placed the skip-road at the several levels, which are opened or closed as occasio requires, but the shaft is not otherwise guarded at the levels. Three ski constructed of strong iron plate are in use at present for lifting ore. The are used also in bringing up and sending down the drills of the miners.

"The shaft has a depth of 200 feet, and its size throughout (including t man-road and skip-road), is 7 by 18 feet. Three levels have been driven fro it on the vein, the first at a depth of 66 feet, the second at 126 feet, and t third at 190 feet from the surface. At the bottom is a sump of 12 feet depth, out of which the collected waters of the mine are lifted by a pump the surface.

No. 1 level.

"No. 1 level is driven north from the shaft 72 feet, and south 90 feet, a from the end of the latter is a cross-cut of 40 feet to connect with the botto of the shaft on No. 2 vein, now idle. Overhead stoping has been done on t south section of this level to a height of 25 feet, the width ranging from 6 8 feet according to the width of the vein.

No. 2 level.

"No. 2 level is driven north 82 feet, from the farther end of which the is a winze opening up to the first level. To the south it is driven 137 fe and at 72 feet from the shaft is a winze which connects with the first a third levels. Overhead the ore has been stoped out almost wholly to the fi level, and the roof and walls secured by timbering. Underfoot stoping h been carried on beyond the winze for 30 feet to a depth of 25 feet, a the vein has been opened to a width of 30 feet without reaching the han ing wall. It will be necessary to timber this part of the workings at early date to prevent the falling or sliding of rock from either wall.

No. 3 level.

"No. 3 level is driven south 100 feet, but it is being used only as roadway for the ore taken out of the No. 2 workings and dropped throu the winze connecting the two levels.

"Tram roads are laid down on each of the three levels, along which the ore skips are conveyed upon cars to and from the skip-road, and the ventilation and drainage of the mine appear to be ample and satisfactory.

"Near the southern side of the location work is carried on upon a fissure vein known as the Crown Reef. From the west slope near the lake an open cutting has been made for a length of 200 feet on the surface, following an irregular east course, and of 150 feet on the floor. The depth of the cutting at the end of the floor is 62 feet from the surface, measured on the dip of the vein, which is about 70° north. The average width is about five feet. Crown Reef vein.

"Work is also going on upon a vein which crosses the northwest headland of the location, where an adit is being driven south at the lake level.

"A dressing room for the men has been built to the south of the shaft house and convenient to it, warmed with steam pipes, and provided with necessary supplies of wash basins, soap and towels. Dressing room.

"The number of men employed at the mine and mill is 40, including 25 miners, 4 trammers, 3 blacksmiths, 2 engineers and 2 firemen, and work is carried on by day and night shifts of ten hours each. Employes.

"The mining captain is Albert Johnson, but the general management is directed by the owner of the mine and works, Mr. John F. Caldwell. Management.

"In addition to the instruction already given for securely timbering the walls between the second and third levels, it is directed that the entrances to the shaft at the several levels shall be guarded in the same manner as at the surface of the shaft, as required by the provision of Rule 7 of section 74 The Mines Act 1892. It is directed further that a ladder way or man-road be constructed from the mouth of the shaft on No. 2 vein down to the cross-cut connecting with the first level of No. 3 vein and carried downward to each of the lower levels as the progress of mining operations shall permit and require, as an additional means of escape for the miners in case of an outbreak of fire, or the inflow of water, or of danger to life from any other cause. Directions.

"The attention of the owner of the mine and of the mine captain is drawn to the provision of section 9 of the Amended Act relating to Mines and Mining (chapter 16, Statutes of 1894) as regards the responsibility of contractors, in case any part of the work in or about the mine is now or hereafter carried on under the contract system. Responsibility of contractors.

"Copies of the Mines Act 1892, bound up with which is the amending Act of 1894, are enclosed herewith for the owner and captain of the mine and works, and their attention is specially directed to the provisions of Part IV. of the former Act which relate to Mining Regulations, embracing sections 53 to 76 inclusive, as well as to section 9 of the latter Act."

The dining camp is cleanly and well ordered, and the table is bounteously furnished with nourishing food. Mr. Caldwell not only treats his men well, but he maintains good discipline among them and no labor trouble has arisen.

At the end of the year it was learned that the shaft had been sunk to a depth of 250 feet, and that saving the loss of a few days caused by a fire in the month of March the mine and mill had been worked steadily throughout the year. The large ore lens south of the main shaft, between the second and Progress of the mine at the end of the year.

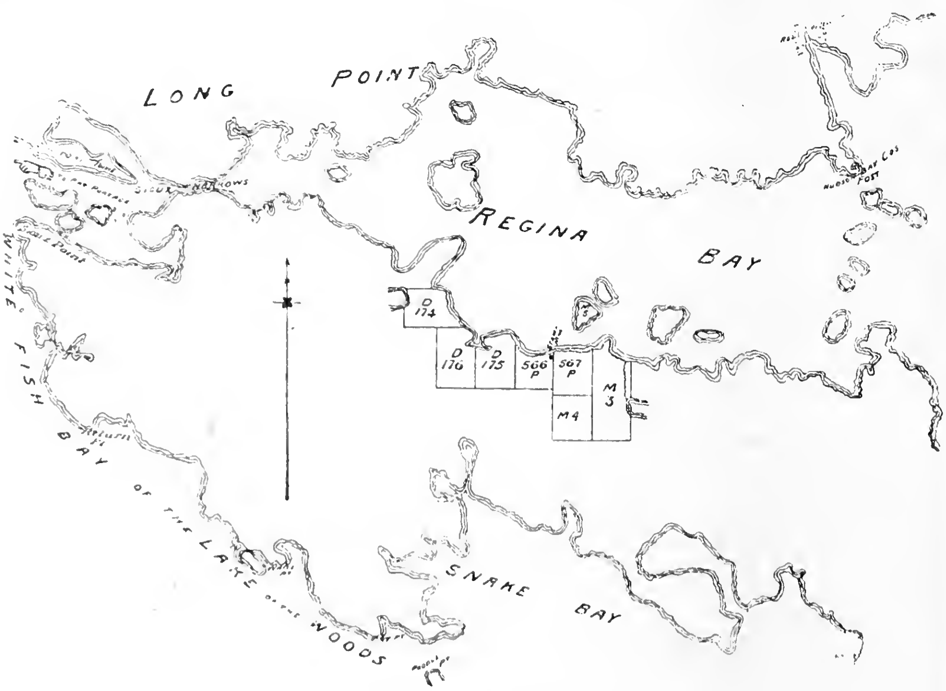
third levels, was so easily attacked that a few miners could keep up t supply for the mill, while others were employed opening up new ground l sinking the shaft and driving levels.

THE REGINA MINE.

Location of the Regina.

The Regina gold mine is one of the most recent of the mining adventur of Lake of the Woods. It is situated on one of the numerous arms of t lake, upon its eastern side, east of the Grand Presqu'ile and Whitefish ba about 30 miles due south of Hawk Lake station on the C. P. R. and 20 mil east of the meridian of Rat Portage; and while in a straight line the distan from the latter place is only 36 miles, it is not less than 45 miles by t water route. A winter road, partly over land and partly on ice, is about : miles.

The manager of the Regina Gold Company, Mr. William G. Motley, M.I came up to Rat Portage on Wednesday evening with the company's stea



Map showing locations of Regina Gold Mine.

launch Eleanor, and offered me a passage when he would return to the mi next day. It was 3.15 Thursday afternoon before he got ready to start, a in addition to a deckload of supplies the little craft had a boat in tow w laden with lumber and other articles required for the mine. There we seven passengers besides Mr. Motley and two of a crew, three of whom we miners going out to work at the Regina, and two were prospectors going do a little exploration work upon a property on Yellow Girl bay. A sma wind was blowing, and a friend took me aside to whisper the counsel—' wouldn't venture the trip in a little thing like that, loaded down to the ra But can you swim?" It did look like a risk, and one is never sure of t wind on Lake of the Woods; but an insurance agent was one of the party, took the risk, and we set off. The lake outside the Devil's gap was only little lumpy, and as the wind slackened the water was soon in condition f

last time. Unluckily however the packing in the cylinder of the engine became loose, and there were neither tools nor materials at hand to repair the damage, so that the rest of the voyage was slow and it was made disagreeable by the escaping steam.

For eight miles after leaving the Devil's gap the course is nearly due south, between Scotty and Middle islands, and through the French Narrows between Allie island and the eastern peninsula, where there is a solitary settler. Thence it is southeast, passing between Ferrier and Shore islands, through Red Cliff bay and past Yellow Girl point[41] into Yellow Girl bay, the western side of which is lined with islands. It was growing dark in this bay, and about midway down it a signal whistle was sounded and two Indians paddled over from their camp upon a small island for the two prospectors. Presently another whistle was heard, and in the darkness another boat was seen threading its way between the islands to meet us, on board of which was Mr. Ahn and a party of prospectors who were out on a tour of exploration. Brief courtesies were exchanged, as they do at sea, and the course was continued. On the southern side of Yellow Girl bay, between two long and narrow points of land, is the mouth of Long bay, a sheet of water varying from an eighth of a mile to a mile wide and 10 or 12 miles long, upon the north shore of Long point. Three miles from the mouth we rounded Rendezvous point and entered what is known as The Passage, a narrow channel with finely wooded banks through which entrance is made into Whitefish bay. The Passage is about a mile long, and it looked very pretty in the darkness. But neither here nor anywhere else on the tortuous course across the bay with its scores of rocks and islets did the man at the wheel seem to have any misgiving; he steered his way as if guided by the instinct of a bird, for to the ordinary eye no object could be seen a dozen yards ahead. Whitefish bay is one of the largest of the numerous bays of Lake of the Woods, and as I saw it returning in the afternoon of next day I think it is altogether the most beautiful. It lies between the ragged mainland and Grande Presqu'ile and has a length of about 12 miles from northwest to southeast, with a breadth of 3 to 5 miles. The water is wholly unlike the rest of Lake of the Woods, being very clear and blue. The reason of this no doubt is that Whitefish bay receives the waters of Crow lake, lying to the east of it—a lake having an area of 100 square miles, 800 feet deep, and in clearness as transparent almost as the air above it. Following close to the southwest shore of Long Point island for 7 or 8 miles we passed out of Whitefish bay through the Sioux Narrows and entered Regina bay; and four miles farther on, nearly due east and upon the south shore of the bay, are the locations of the Regina Mining Company. We reached the floating dock at the camp at 10 o'clock, having taken $6\frac{3}{4}$ hours for the trip: the usual running time of the Eleanor, I was told, is $5\frac{1}{2}$ hours.

The route to the location.

Whitefish bay.

[41] Dr. Bigsby, who went over this route in 1823 into Whitefish lake as he calls it, refers to an island of the same name which is described as "small, woody and rather high," and he adds: "It takes its name from a young girl in a yellow dress having been seen standing on one of the cliffs. She disappeared on being searched for." Vol. II., p. 310. This island is not clearly identified on Bigsby's map, but is one of a group of small islands situated south of the headland now called Yellow Girl point: it is not named on the modern maps.

The Regina Mining Company.

The Regina Mining Company has been reorganized out of the Rajah Gol Mining Company of London, Eng., which in 1893 had done exploration worl on location 317P, five miles northeast of Rat Portage.[42] Mr. Pascoe, a min ing expert of large experience, was sent out in the summer of 1893 to examin the property, and he made an unfavorable report upon it. In the followin year Mr. Motley also condemned it, after which he was instructed to repor upon other properties in the district. He spent several weeks visiting variou locations, and finally made choice of those on what is now named Regina bay as being in his opinion the most promising at that time in the market. Ther were two locations, 566P, 35 acres, and 567P, 42 acres, which had been take up by Messrs. Paul Proulx, Jacob Henesy and John McLean, and these wer

Exploration work.

purchased in the fall of 1894 at a price variously reported at $10,000 t $14,000. A little work was done that year; a house was built for th employés, and a small clearing was made, but actual mining was not unde taken until the spring of the following year. In May and June material were collected for the mill, and on 1st July the work of construction wa commenced under the charge of Mr. Otto F. Purnall, whose services wer placed at the disposal of the Regina Company by the Gates Iron Company o Chicago, who obtained the contract to supply the batteries. On 5th Septem ber the mill was completed and the machinery set in motion. The entr made in the Inspector's book under date of September 13 furnishes all nece sary particulars of the mine and works:

Entry in the Inspector's book.

"I have to-day examined the mine and mill of the Regina Gold Min (Limited), on behalf of the Inspector of Mines.

The Company

"This is a company organized under an English charter, with the hea office in England, and represented by W. G. Motley, M.E., as resident mana ger. William Caldwell is employed as mine captain.

and its property.

"The property of the company is situated on Whitefish bay,[43] in Lake o the Woods, and consists of locations 566P, 35 acres, and 567P, 42 acres.

"Upon the water front the formation is granite, backed at some distanc from the shore with a formation of schistose rock. On location 566P ther are three fissure veins in the granite, which extend into the schist, and on bedded vein in the schist, all of which are claimed to carry gold.

Prospecting and mining operations.

"Prospecting work has been done upon each of those veins, but only upo No. 3 has work been carried on to any considerable extent. This vein i near the eastern boundary of the location, and it extends into 567P, having course of nearly southeast and northwest for a distance of 200 feet from th lake. At this point it enters the schist and turns to an east and west cours for 250 feet, and again resumes the northeast and southwest course. A shaft has been sunk upon it to a depth of 50 feet, neatly and substantiall timbered to a depth of 20 feet. The average width of the vein is 2 feet inches, and although irregular it is enclosed by good walls. The dip is 75° towards the west. The size of the shaft inside the timber is 6 by 10 feet

[42] The Rajah had a capital of £170,000; the Regina's capital is £130,000. Its presi dent is Lieut.-General H. C. Wilkinson, of London, Eng.

[43] This is the usual description of the locality, but in reality it is on Regina bay, whicl is connected with Whitefish bay by the Sioux Narrows.

whereof 6 by 6 feet is a skip way, and 4 by 6 feet a man-way, separated by a board partition to 30 feet. The entrance to each opening is protected by trap doors, but without fence or railing as required by No. 7 of the General Rules, section 74, The Mines Act 1892. A ladder inclined at the most convenient angle, and with platforms at intervals of 15 feet, has been constructed for the man-way, and is securely fixed in place.

"A tunnel or adit has been driven upon the vein to a length of 77 feet measured from the mouth of the shaft, and at 70 feet a winze has been sunk 10 feet below the floor. The width of this vein at the shaft's mouth and for a length of 35 feet on the floor of the adit is 8 feet, at which point it appears to be split; at 50 feet the main vein is 4 feet wide at the floor, and at the top of the slope, 26 feet above the floor, it is 2 feet 8 inches. Along the adit and to the bottom of the shaft the walls, although irregular, are clearly defined and show a dip of about 75° west.

"It is estimated that 300 tons of ore are lying on the dump for milling, the product of mining operations in the months of May and June. At the end of the latter month mining was suspended in order that work of mill construction might not be hindered.

"The buildings consist of the mill, shaft house (which is connected with the mill by an enclosed gallery), dining camp, office, blacksmith's shop, and magazine. The men at present occupy tents for sleeping, but a log house for their better accommodation is in course of erection. A dock has been constructed convenient to the mill, and alongside it the depth of water is 15 feet. Buildings

"The mill is a well built frame structure, and is equipped with an engine and boiler of 40 h. p., a grizzly and a No. 7 Blake ore crusher, an ore bin of 50 tons capacity underneath the crusher, two Gates' batteries of five stamps each, the stamps of 900 pound weight and dropping 8 inches at a speed of 80 per minute to crush the ore, which is delivered by two automatic Tulloch feeders, front and back plates, 45 mesh screens, and outside plates of 4½ by 10 feet to take up free gold, two Perfection concentrators, with amalgamated bottoms, manufactured by the Colorado Iron Works, four slime cloths each 2½ by 16 feet, air compressor No. 2 of the Canadian Rand Drill Co's manufacture, and an air receiver of 3 by 6 feet to supply power for drills, a dynamo of 100 lights capacity driven by an engine of 10 h. p., and a water tank of 2,200 gallons capacity on the third floor to supply the batteries, and with water plugs on each of the three floors of the mill for connection with hose for fire protection. The shaft house is provided with a steam hoist and wire cable, and iron tramways are laid down from the mouth of the shaft and from the adit, with turn table to the ore and rock dumps outside, and to the grizzly in the mill. A proper system of signalling, with printed instructions, directs the operations of the hoist. and plant.

"Construction work upon the mill was commenced on 1st July, and the first run of the stamps upon ore was made on 5th September.

"Thirty-five men are employed at the works, of whom 18 are miners working in two shifts per day of ten hours each, 4 engineers, 4 mill men, 3 surface men, 2 blacksmiths, 2 cooks, 1 foreman and 1 clerk. Employés.

Directions.

"All fly wheels and other dangerous parts of the machinery of the mill are safely guarded by railing, but for greater security it is directed that a rail be placed alongside the carpenter's platform upon the right hand, and also at the ascent of the stairway on the second floor. It is furthermore necessary that the entrances to the skip-way and man-way of the shaft be protected by railing, as required by No. 7 of the General Rules of The Mines Act 1892, section 74. A dressing room for the miners should also be provided, as required by Rule 17.

"Two copies of the mining laws of the Province are presented herewith, one for the resident manager and one for the mine captain, whose special attention is directed to the provisions of Part IV. of The Mines Act 1892 (sections 53 to 76 inclusive), under the head of Mining Regulations, and to section 9 of the amending Act of 1894 which relates to the responsibility of contractors. The Regulations affixed to the outside cover of this Book, which have been made by Order in Council, printed in the Ontario Gazette and approved by the Legislature, have the full force and effect of law as provided by section 6 of The Mines Act 1892."[44]

Samples of rock from the location were selected, which have been submitted to Dr. Coleman for identification. Thin sections were made by him of the three different varieties, and he has given me a report on them.

The country rock.

The sample from the granitic rock along the shore of the bay Dr. Coleman describes as "a medium grained, flesh-colored, somewhat schistose rock, probably a crushed or sheared plagioclase granite. Under the microscope it presents a characteristic cataclase or crushed structure, especially in the quartz grains, which often have a mosaic rim of broken particles. The felspar is greatly decomposed, but seems to be plagioclase where fresh enough to determine. Much of it has been turned into colorless muscovite in crumpled leaves, which suggests a potash felspar. Some cubes of pyrite occur in it."

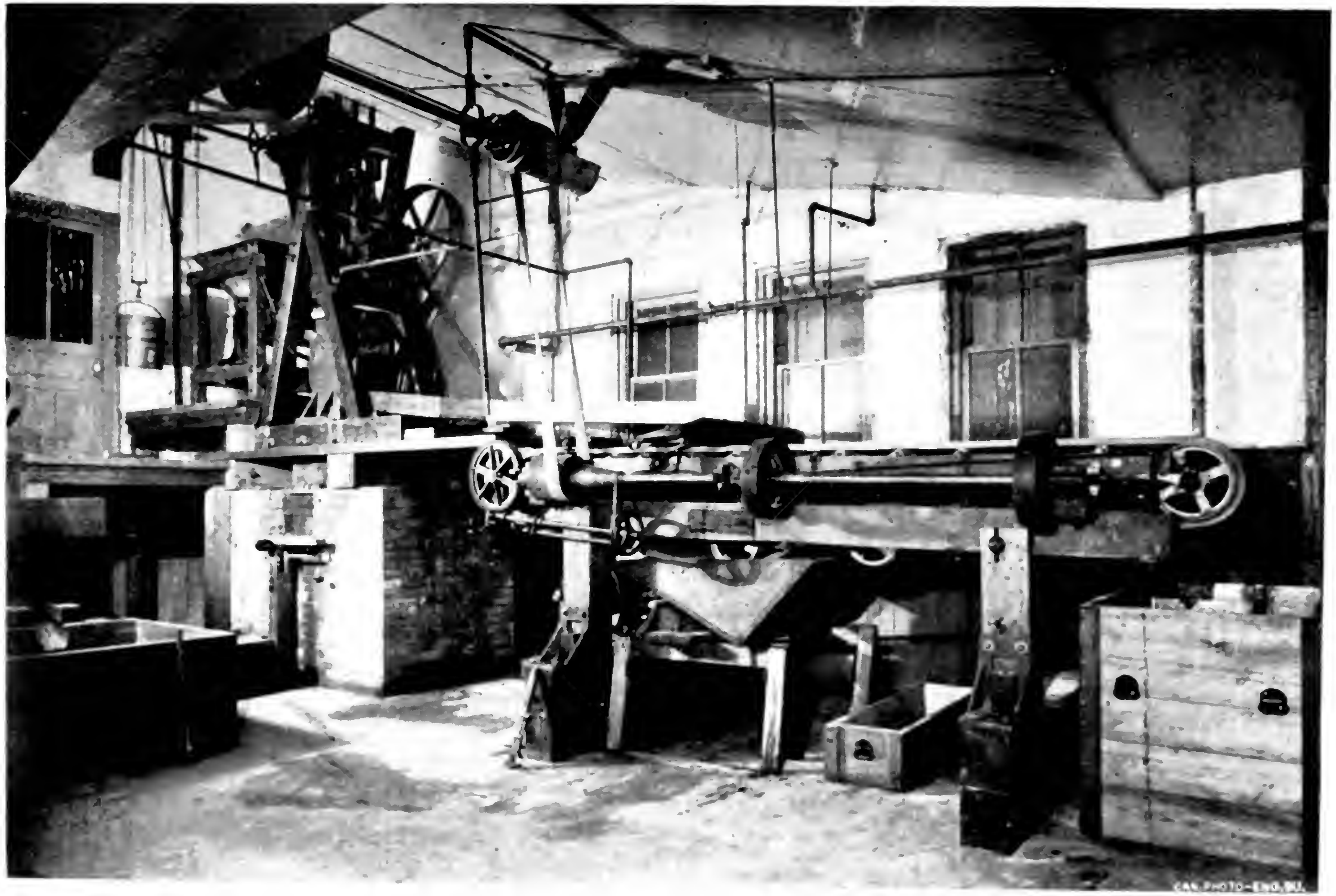
The green colored rock forming the extensive area of country rock south of the altered granite is described as "a hard gray green, very fine grained rock, probably schistose but possibly massive. Under the microscope one finds chiefly chlorite, some carbonate (probably dolomite), magnetite and a little quartz. The rock may be called a chlorite schist, but is probably a greatly metamorphosed basic eruptive, or a basic volcanic ash."

On the high ridge southwest of the mill and near the line of contact there are evidences of considerable disturbance, and greenish and light colored rocks are confusedly mixed to form a band or dike several feet wide in the granite. A sample taken from this band Dr. Coleman describes as "medium grained, yellowish flesh colored and massive looking. It contains pyrite, which has weathered to yellow brown limonite. Under the microscope it is seen to consist almost wholly of quartz, with tolerably fresh felspar (orthoclase, microcline and plagioclase) beautifully intergrown, forming

[44] Late in the year fire broke out at the mill which resulted in the destruction of the shaft house; but the system of fire protection provided for enabled the employés to confine the flames to that portion of the buildings, and beyond the loss of it Mr. Motley reports that no great damage was done.

Rat Portage Reduction Works, west side, p. 187.

Rat Portage Reduction Works, north side, p. 187



Stamp Mill, School of Practical Science, Toronto, p. 212

the pegmatitic or granophyre structure. It may be called granophyre, or graphic granite, and is probably a dike rock"

A fine view across Regina bay is presented from the mine, looking north and northeast. Numerous small islands dot the water, and about two miles to the northeast, at the eastern end of Long Point island, may be seen the buildings of a Hudson's Bay Co. post. Through a strait four miles to the east come the clear waters of Crow lake, Sturgeon lake, Rowan lake, Black Bass lake and many others in the pine woods eastward of Whitefish bay. Across Regina bay.

Friday afternoon at 2 o'clock we left the Regina mine for Rat Portage. The cylinder of the Eleanor had been repaired in the interval, and with a light load she made a quick passage. A strong wind arose towards evening, and in crossing the traverses of Lake of the Woods north of Allie and Scotty islands the waves frequently broke over the bulwarks of the little craft, threatening to swamp it. The pump was kept steadily working, although it was not capable of doing more than half duty; but the numerous islands broke the force of the waves and we got through safely, reaching Rat Portage at 7 30 o'clock. It is surprising how venturous in a short time mining men grow on Lake of the Woods, knowing how suddenly wind gusts arise upon it and how quickly its shallow waters are lashed into fury; yet accidents are of rare occurrence, as boats are usually able to get into the shelter of a friendly island. Back to Rat Portage again.

LOCATIONS IN JAFFRAY TOWNSHIP.

The township of Jaffray lies to the east and northeast of Rat Portage, and was surveyed into lots in 1894. Previous to that time a number of mining locations had been surveyed and taken up within the boundaries of this township, and during the past two years some new discoveries have been made which may prove to be valuable when they have been properly opened up. Hitherto exploration in the district has been carried on almost wholly along the shores of canoeable waters, for excepting in pine belts the forests are so dense as to suggest a tropical jungle. Where surveys have been made however, or fires have broken out, or timber has been cut for any purpose, there is a chance of looking for mineral-bearing veins with some hope of discovery, and in Jaffray township prospectors have been rewarded with gold finds at a number of points in the interior and away from the water routes. Difficulties of inland exploration.

The south half of lot 15 in the fifth concession was under option last summer to Messrs. Hay and Ahn, and some prospecting work was done upon it. The formation is green schist, with a strike of northeast and southwest. A bedded vein with a dip of 70° north has been explored for a length of 125 yards, and at the eastern end it has been exposed by a trench and cross-cutting for a length of 15 yards. A shaft of 8 by 12 feet has been commenced here which has been sunk to a depth of 15 feet. The vein matter is banded quartz and schist, and pannings made by Mr. Ahn showed many colors of fine gold. However, it is never safe to count on the value of these ores by colors of gold, as owing to the fineness of the grains the actual yield may prove to be disappointing. A mill test is required to show their actual value. A comfortable log building has been put up on the lot for housing the miners employed in the exploration work. The lessees from the Crown are Messrs. Alfred Goulet, Albert Goulet and G A. Kobold. Lot 15 in the fifth concession.

The Scramble mine.

In July of last year a discovery of gold was made on lots 13 and 14 in the sixth concession, and applications were made for portions of both lots by prospectors Henry Benson and Andrew Norman. An option on the locations was given to S. V. Halstead of Chatham, and prospecting work was undertaken to show the extent and quality of the mineral-bearing veins. When I visited the property on 19th September (which is known as the Scramble mine) a shaft of 6 by 8 feet was in course of being sunk on a large bedded vein close to the line between the two lots, which had at that time reached a depth of 14 feet. The formation is green schist, with a strike of northeast and southwest, and the Laurentian rocks lie close to it on the east side. The vein consists of banded quartz and schist, carrying very considerable quantities of iron and copper pyrites, has a width from wall to wall at the shaft of 28 feet, and dips to the northwest at an angle of 72°. Free gold was observed at several points in the shaft, and pannings of the ore showed a tail of gold in almost every instance. Mr. Halstead disposed of a large portion of his interest in the property to Mr. L. W. Partridge of Detroit, by whom prospecting work was carried on to the end of the year. The shaft has been sunk to a depth of 54 feet, and a cross-cutting at that depth showed the vein to have a width of 27 feet from wall to wall. Mr. Partridge has since secured the title to four locations of forty acres each on the two lots, and he reports that mill tests of the ore made at the sampling works of Ricketts and Banks in New Jersey, and elsewhere, have given very satisfactory results. A log house has been built on the property for the accommodation of the employés.

Prospecting work and mill tests.

GOLD MOUNTAIN MINE.

Gold Mountain mine, on the Western peninsula.

Numerous locations have been taken up on the west side of Lake of the Woods, but the only one upon which work was carried on last year is what is known as Gold Mountain mine. It is situated on the Western peninsula, about twenty miles southwest of Rat Portage, and not far from the line of steamboat travel to the mouth of Rainy river. I left Rat Portage on Friday morning, September 20, by the steam tug Queen, and made the run in a little over two hours. It was a delightful day, with a clear sky and balmy air, and the many islands and headlands passed on the way were resplendent in the riches of their autumn foliage. Taking the usual course out of Rat Portage through the Devil's gap, we steered to the southwest, by Aylmer point, Thomson's island and Wolf point on the right, and Manitou and Whiskey island on the left, and through Crow Rock channel between Crow Rock island and the peninsula, into Wiley bay. The pilot supposed the mine to be near this sheet of water, and the whole coast line was skirted to discover a landing place, but in vain. Turning at Wiley point on the south side of the bay, two canoe loads of prospectors were met who gave us directions. Two miles farther on, upon a headland of chlorite schist, the dock was reached and the tug tied up. A road leads two miles inland through the woods to the Gold Mountain mine, on location 48P, the patent for which was acquired five years ago by E. V. Wright of Ottawa. It lies between two small lakes, one upon the south and the other upon the north side, which occupy depressions about a hundred feet below the table land. The lake upon the south is

Location 48 P.

named Lily lake, from the many lilies which grow in its shallow water, and near to it a neat boarding camp has been built. The formation is a greenish gray schist, having a strike of northeast and southwest, and standing apparently on edge, but in the shaft that has been sunk on the location there is said to be a very slight dip westward. A banded vein of quartz and schist is exposed on the steep bank of Lily lake and has been traced across the location near to the lake upon the northern side, a length of nearly 1,500 feet. The foot wall is clearly defined for some distance north of Lily lake, and measurements show the width of the vein to vary from 25 to 65 feet. A shaft has been commenced at a point about 400 feet from Lily lake, on the foot wall, which is said to have reached a depth of 30 feet; but work upon it had been discontinued a short time before my visit and it was filled with water to within 15 feet of the top. A mass of white quartz is exposed by this opening which carries large quantities of iron pyrites and a little copper pyrites, and I was informed that assays of thirteen samples made by Prof. Donald of Montreal (who had examined the property) gave an average of $12.72 per ton. A sample of the country rock taken from the foot wall is described by Dr. Coleman as "a pale green, very schistose and compact rock sprinkled with cubes of pyrite. It consists mainly of quartz in very minute grains and scales of muscovite or sericite, and may be called a sericite schist." The machinery on the ground consisted of a 24 h.p. upright boiler, two steam drills and an Ingersoll hoist. The principal owners are E. V. Wright of Ottawa and James Foley of Montreal, and M. P. Wright was in charge as manager. A number of men were employed getting out timber for necessary buildings.

The return was made along the west shore of the lake, through the channel on the west side of Treaty island and around Coney island upon the north—which affords one of the most charming bits of scenery on Lake of the Woods—and we arrived at Rat Portage at 8 in the evening.

THE RAT PORTAGE REDUCTION WORKS.

I had made several visits to the Reduction Works at Rat Portage, which were in course of reconstruction, and I spent several hours in them on Saturday previous to leaving for the east. It has already been stated that these works are the property of the Dominion Gold Mining and Reduction Company, having been acquired with other properties of the Black Jack Mining Company under a sale by order of the court. The mill was built in 1890, and it has since experienced several changes of ownership and management as well as attempts at improvement, without however making a return of much value for the money and labor expended upon it. It was indeed a "ramshackle" concern from the first, and the $75,000 or $80,000 which it is said to have cost was for the most part wasted because the men who had the spending of the money were lacking in the skill which an enterprise of this kind calls for. Reduction Works at Rat Portage.

The new owners have commenced with a scheme of thorough renovation, and a capable and experienced man, Mr. O. F. Purnall, was put in charge of the improvements. The old plant for milling the ore, which consisted of two Standard pulverizers, has been replaced with four batteries of five stamps each, two of them from the works of Fraser & Chalmers, of Chicago, and Renovation of the plant.

two from the works of Ribon & Marche, of Jersey City. The foundation for the batteries is built upon solid rock with stone and cement mortar, and heavy timbers of British Columbia pine. Each of the mortars rests upon battery blocks constructed of plank set upon end and spiked together, according to the most approved modern plan. The crushing plant consists of a Blake and a Lynn breaker, each with a capacity of 120 tons of ore per day. Four bins with a capacity of 25 tons each receive the ore from the breakers, and deliver it to the batteries through Tulloch feeders. The limit of the stamps however is only 50 tons per day, and in practice will probably not exceed 40 tons. After being washed out on the amalgamated plates, the pulped ore is carried over a series of concentrating tables, of which there are provided for the four batteries two Perfection concentrators, two Krupp vanners, three Frue vanners and three slime vanners; and provision is made for putting in slime tables of canvas to catch floating particles of gold should they be required. A four-hearth reverberatory furnace has been constructed for treating the concentrates, with grinders and amalgamators, the capacity of which will be ten tons per day.

These works have been fitted up with a view to treating ores mined upon the Company's locations at various points upon the lake, and also to do custom work for owners of other properties should the ore be supplied. Their situation on the lake and close to the line of the Canadian Pacific Railway is well suited for the delivery of ore, fuel, etc., while their proximity to the town's electric works suggests the possibility of electricity being used alike for driving power and in the treating processes.

Situation of the works.

The Return Journey.

An equinoxial storm.

We had been favored with very pleasant weather from the outset of the tour until now. In the six weeks since leaving Windsor on the Alberta we were delayed only half a day by rain or wind; and while we experienced a few days of intense heat, the temperature generally was moderate and agreeable. The air of those northern regions is very invigorating, and the out-of-doors life that one is obliged to lead who travels as I did conduces to hardiness and healthiness. But the regular equinoxial storm was now due, and at noon of Saturday, 21st September, it set in with a downpour of rain. The rain fell heavily the whole afternoon, until the train carried us out of Rat Portage at 18 o'clock in the evening; it continued to fall all night; it was coming down in torrents next morning when the train arrived at Port Arthur; and it kept on without cessation there all day, until nearly midnight, when the rain gave place to a strong gale of wind.

A trip to Silver Islet and Black bay.

The prospect of a sail out to Silver Islet and to Black bay, which Crown Timber agent Munro had planned, did not look very promising; but by noon the wind had abated somewhat, and at 1.30 p.m. we started out on the staunch steam tug Georgina, Capt. Nicholas Marin. A steamer with two sailing vessels in tow was met near Thunder cape; the vessels had been disabled in the gale, and were going in to port for repairs. Outside of the cape a heavy sea was on, but the Georgina rode the waves splendidly, and brought us to Silver Islet dock in two hours. Next morning she continued east by Edward's island, where work had been done upon a silver mine in

1892, and thence into Black bay, where I had an opportunity of seeing extensive beds of brown sandstone underlying a mass of trap overflow. Farther north, on the east shore of the bay, is a deposit of magnetic iron sand extending for half a mile or more along the beach. Like the deposit at Moisie on the river St. Lawrence, it contains a small percentage of titanium, and is probably unfit for use. Mixed with it also are minute grains of garnet, which look beautiful under the glass. We got back to Silver Islet harbor Tuesday night, and Wednesday forenoon Mr. James W. Cross (who is in charge there) showed us over the old workings on the islet and also the mill upon the mainland. Many interesting particulars of Silver Islet from beginning to close of that enterprise were given me by Mr. Cross and Capt. Marin, both of whom had been employed at the works from the commencement of operations, and I had hoped to make use of them in this Report in writing a narrative of the great mine; but failure to procure other materials necessary for the completion of that task has obliged me to defer it for a time. We reached Port Arthur early in the afternoon.

I had in view a visit to the newly discovered gold property of the McKellar Brothers near Jackfish bay on the journey eastward, but learned on returning to Port Arthur that prospecting operations had ceased there on the Saturday evening previous and that owing to the heavy storm, which had destroyed all the canoes and small boats on Jackfish bay, it would be exceedingly difficult to get to the locations. Mr. Peter McKellar of Fort William, who had just returned from the mine, gave me an account of the work which had been done in exploring the veins, and the following statement is given as supplemental to the report of Dr. Coleman, who visited the locations about the middle of August.

The Empress gold mine

An interview with Peter McKellar.

"Locations 567, 568 and 569R have been surveyed within four miles of the Canadian Pacific Railway at Jackfish bay, as shown by the surveyor's sketch—R569 being the westerly, R568 the easterly and R567 the middle one of the three locations. The first discovery of gold was made upon the last named in June of this year, specimens from which were shown to my brother Donald by an Indian; and after testing the ore and examining the vein the Indian's rights were purchased. A further examination was undertaken by Donald and myself, and tests were made which resulted in further discoveries. A surveyor and five men were employed to lay out the three locations, but owing to the dense growth of timber, chiefly birch, it took two weeks to complete the work. All the timber there is green, no fire having touched it, and although the trees are not large they spread wide, a number growing from the same roots, and the work of running lines is very difficult in consequence. The first work of exploration was done on 567R, with a party of fourteen men. The country rock is Huronian, composed of green schists, but the selvage of the vein is a talcose schist varying in width from 30 to 60 feet. The quartz is sometimes enclosed in this schist and again runs on either side of it. It occurs in lenses, alternating with the slate or mixed with it; but at the western end, in 569R, the quartz is nearly solid. At first it was supposed to be a bedded vein, running with the formation, but later work leads to the belief that it is a fissure vein. Cross-cuts on the

Description of the locations.

Exploration work carried on.

middle vein show it to dip 45° south ; on the west location the dip is much steeper, being nearly vertical in places, ranging from 45° to 90°. The general course is about east-northeast and west-southwest, and we have traced it by cuttings for about a mile—across the whole of 567 and portions of 568 and 569. Six cross-cuts were made on 567, one of which was sunk in the middle to eight feet. At this point the vein is 35 feet wide, composed of quartz and slate and all of it carrying auriferous sulphurets, and free gold was obtained by washing. All the other cuttings proved a width of not less than 20 feet. On 568 two openings were made, showing a width of 20 feet of quartz and slate, carrying gold ; the eastern end on this location is covered with boulders and drift. On 569 three points were cross-cutted and several pits were sunk. Two of the cuttings showed 20 feet of quartz and only a little of slate. At eight chains from the line part of the vein is deflected towards the west-northwest, crossing the formation in a zig-zag line for at least 100 feet, and then continues nearly west until it is lost under the drift; the other part of the vein continues along the line of bedding. Two pits have been sunk on 569, one of which is 20 and the other 25 feet wide and eight feet deep. Altogether about 200 tons of ore have been raised of good mill rock, and all the work was done from 26th August to 21st September. A mountain 600 feet above the level of lake Superior at two miles from the water's edge crosses the properties in a west-southwest and east-northeast direction, and the vein lies parallel with it for half a mile, near its crest on the middle location and 100 feet below on the western one. The land falls away in a succession of benches down into the valley at the north end of Jackfish lake or Inner bay, while between the latter and Jackfish bay is a ridge of granite about 500 feet high. A ton of ore has been taken out to the railway station for a mill test, the results of which will determine the next course to be taken. We are confident from the hundreds of tests made by pulverizing in a mortar and washing out the free gold that the yield will be satisfactory. The ore is well charged with iron and copper pyrites and galena, and even where the quartz seemed to be white it is found when broken to carry sulphurets. The total area of the three locations is 480 acres, and further prospecting is to be carried on."

Organizing a company.

As a result of the tests a company has been organized to work the properties under the title of the Empress Gold Mining Company, with a capital stock of $100,000, nearly all of which has been taken up at Port Arthur, Fort William and Rat Portage, and preparations are going forward to sink one or more shafts and to put up a ten-stamp mill.

To Toronto by rail.

Thursday morning, 26th September, I resumed the journey east by rail, reached Sudbury next morning and spent part of the day at the Canadian Copper Company's works. Saturday I visited the Bonanza Nickel Mining Company's gold mine near lake Wahnapitæ, where the diamond drill was prospecting a large vein under the management of Mr. Roche, of which an account is given elsewhere ; and being detained at the camp by a storm of rain and sleet, I did not arrive at Toronto until Wednesday evening, 2nd of October.

A. B.

SECTION IV.

THE NEW ONTARIO.[1]

The New Ontario is a title which in the common use describes all that part of the Province lying beyond the Mattawan and French rivers, and the Nipissing, Huron and Superior lakes, to the north and west boundaries. These boundaries, now clearly defined and established by an Inperial statute, were for nearly twenty years a subject of keenly waged dispute between the Governments of Ontario and the Dominion ; and at one time, after Manitoba had been projected into the quarrel, feeling ran so high that recourse to arms was imminent. The extent of country involved in this dispute, while very much larger, is perhaps not less valuable in its resources of timber and minerals than the region in dispute between Guiana and Venezuela, over which the two great Anglo-Saxon nations were just now talking of war. In one important particular, too, there is a close parallel in the conduct of the negotiations. The President of the United States has named Commissioners to determine what is the true divisional line between British Guiana and Venezuela ; and this work being done, he declares it will be "the duty of the United States to resist by every means in its power, as a wilful agression upon its rights and interests, the appropriation by Great Britain of any lands or the exercise of governmental jurisdiction over any territory which, after investigation, we have determined of right belong to Venezuela." The Government of Canada also, at an early stage in the negotiations with Ontario, and before any limits were proposed or discussed, appointed a commissioner and authorized him to proceed and trace out, survey and mark the boundaries on the west and north of the Province according to the specific and definite instructions given to him. The same arbitrariness appears in both cases ; but in the action of the Government of Canada in 1872 there was a tangible interest at stake, and in the action of the Government of the United States in 1896 there is nothing but a sentiment. Had the Government of Ontario tamely acquiesced in the instructions issued from Ottawa, instead of vigorously contesting their claim to the final award, it would have meant to this Province the loss of 100,000 square miles of territory.

Extent of the region,

and how its boundaries were settled

The New Ontario lies within boundaries declared by the Imperial Parliament in 1889, in an Act passed in accordance with the terms of an address from the Senate and Commons of Canada presented to the Queen in that year. These boundaries are substantially the same as those agreed upon in 1878, in the award of the arbitrators appointed by the Dominion and Ontario Governments, but subsequently repudiated by the Dominion Government ; and, as far as they go, they are identical with the boundaries found by the Judicial Committee of the Privy Council in 1884. In the schedule to the Imperial Act they are described as follows :

and defined by the Judicial Committee of the Privy Council.

"Commencing at the point where the international boundary between the United States of America and Canada strikes the western shores of lake

[1] A paper read before the Hamilton Association, in the city of Hamilton, January 16th, 1896.

Superior, thence westerly along the said boundary to the northwest angle of the Lake of the Woods, thence along a line drawn due north until it strikes the middle line of the course of the river discharging the waters of the lake called lake Seul, or the Lonely lake, whether above or below its confluence with the stream flowing from the Lake of the Woods towards lake Winnipeg, and thence proceeding eastward from the point at which the before mentioned line strikes the middle line of the course of the river last aforesaid, along the middle line of the course of the same river (whether called by the name of English river or, as to the part below the confluence, by the name of the river Winnipeg) up to lake Seul, or the Lonely lake, and thence along the middle line of lake Seul or Lonely lake to the head of that lake, and thence by a straight line to the nearest point of the middle line of the waters of lake St. Joseph, and thence along that middle line until it reaches the foot or outlet of that lake, and thence along the middle line of the river by which the waters of lake St. Joseph discharge themselves to the shore of the part of Hudson bay commonly known as James bay, and thence southeasterly, following up the said shore to a point where a line drawn due north from the head of lake Temiscaming would strike it, and thence due south along the said line to the head of the said lake, and thence through the middle channel of the said lake into the Ottawa river, and thence descending along the middle of the main channel of the said river," etc. to a stone boundary on the north bank of lake St. Francis in the St. Lawrence river.

Eastern and western boundaries.

The eastern boundary of the Province was first determined in 1791 by the Imperial Order in Council establishing the Provinces of Upper and Lower Canada, including the section of it from the head of lake Temiscaming defined by "a line drawn due north until it strikes the boundary line of the Hudson bay." The exact starting point of this line was finally fixed in 1872, by agreement between the Governments of Ontario and Quebec, in 1873 and 1874 it was surveyed as far north as the height of land by joint commissioners appointed for the purpose, and in 1874 the line was ratified by the Legislatures of the two Provinces. As laid down on the maps, it starts from the parallel of 47° 33′ 48″ 37‴ and is as nearly as may be along the meridian of 79° 30′ west from Greenwich. The western boundary is the meridian of the Northwest Angle of Lake of the Woods, and the joint commissioners under the Treaty of Ghent ascertained this point to be in latitude 49° 23′ 55″ north and in longtitude 95° 14′ 38″ west from Greenwich.[2] The New Ontario therefore extends across 15° 44′ 38″ of longtitude, which on the latitude of 50° measures 701 statute miles.[3]

Length, breadth and area of the New Ontario.

The greatest breadth from north to south, measured from the mouth of the Spanish river in Georgian bay to the mouth of the Albany river in James bay (or say from 46° 15′ to 52° 30′ north latitude) is about 430 miles, and the least is along the western boundary, where it is only about 80 miles. From the mouth of Pigeon river on the Minnesota boundary to the foot of lake St. Joseph, near the meridian of 90°, it is about 215 miles; from Fort Michi

[2] Report of the Commissioners under the Treaty of Ghent made 23 October, 1826. Hertslet's Treaties, vol. xiii., pp. 898-9.

[3] The length of a degree of longtitude on the parellel of 50° is 235,171 feet, or about 44.4 English statute miles.

picoten on the east shore of lake Superior to Henley House on the Albany river, along the meridian of 85°, it is about 240 miles; and the average breadth is probably 250 miles. The area has been variously estimated; it is not less than 150,000 square miles, and it may be 175,000 square miles. Even at the lower of these estimates it is larger than Minnesota and Wisconsin by 16,000 square miles, larger than Wisconsin and Michigan by 44,000 square miles, larger by 7,000 square miles than three States the size of New York, and larger than our part of Ontario south of the French and Mattawan rivers by 100,000 square miles. The passenger train on the Canadian Pacific Railway which leaves Mattawa at the mouth of the Mattawan river at 8.11 o'clock Monday evening, and goes at a speed including all stops of 25¼ miles per hour —through North Bay and Sudbury, coasting the north shore of lake Superior 195 miles from Heron Bay to Fort William, and on through Rat Portage at the foot of Lake of the Woods—does not reach Ingolf station near the Ontario and Manitoba line until 11.57 a m. on Wednesday. But the length of the run is 1,004 miles.

From these figures and comparisons it is seen that the New Ontario is a large country—doubtless much larger than most of us down here have ever conceived or suspected, for I think it must be confessed that even the best informed among us have a great deal yet to learn of its lengths and breadths, as well as of its physical aspects and varied resources.

Geologic History of the Region.

The primitive nucleus of the continent.

But is not the title of the New Ontario something of a misnomer? May we not say that it is really the Old Ontario? Is it not the very oldest part of our continent, and has it not furnished the materials out of which not alone this lower Ontario but many States across the great lakes have been built up? Almost the whole extent of it, all excepting a portion of the Hudson Bay slope and a small area around lake Temiscaming, is a mountain built country. Through long cycles of time the most conspicuous physical feature in North America was the high range of Archæan rocks which swept in a magnificent curve through what is known in our time as the regions of Labrador, Quebec, Ontario and the Northwest Territories, around the head of Hudson bay, from the Atlantic ocean in the east to the Arctic in the north. These rocks covered an area of over 2,000,000 square miles, and we can hardly guess the height to which they were raised by the forces that heaved them into mountain masses long, it may be, before there was any sea. The average elevation is from 1,500 to 1,600 feet above the present sea level according to Logan, and probably less than 1,000 feet according to Selwyn There are many points of 2,500 to 3,000 feet; in the Adirondacks are mountains more than 5,000 feet above the sea; and along the eastern and northern coasts of Labrador are chains estimated at heights from 5,000 to 10,000 feet. It is supposed that the denuding forces were not so great or so active in Labrador as farther west; and having in view the immense extent of the sedimentary formations, from at least the base of the Huronian upwards through the Cambrian, Silurian and Devonian systems to the relatively recent glacial drift,

which cover the region of the lakes and beyond them south and west to a depth in places of many thousands of feet, and the fact that the materials of all these excepting part of the limestones were derived from the ancient rocks of the north, the conclusion appears to be irresistible that the range or ranges, for probably there were several parallel ones, must have reached a lofty height throughout their whole extent. Logan about forty years ago gave to this primitive nucleus of the continent the name Laurentian, from the rocks which compose it forming the high mountainous country known as the Laurentides, which extend for nearly a thousand miles north of the river St. Lawrence from Quebec into Labrador. He maintained that the rocks of the Laurentian system are almost without exception old sedimentary beds which by action of heat have become highly crystalline, composed of schists, felspars, quartzites and limestones, with intrusive masses of granites, syenites and diorites, and that their aggregate thickness is not less than 30,000 feet. It seems probable however that a number of the rocks which Logan has described as stratified are of purely igneous origin, and that their foliated structure is a result of folding and shearing when under great pressure they were being raised into mountain forms. The fine-grained hornblende-gneisses, the mica-gneisses and the chlorite-gneisses are of this class, and are often traced into massive granites and granitoid gneisses, which are clearly igneous. "All of these rocks," Van Hise says, "are completely crystalline. None of them show any unmistakeable evidence of having been derived from the sedimentaries, but many can be traced with gradations into massive rocks, and therefore the greater proportion of them are igneous, if a completely massive granular structure be proof of such an origin."[4] So also Dr. Adams affirms that the indistinct foliation of the fundamental gneiss—a term used to designate the lower portion of Logan's Lower Laurentian,—is not in many cases "a survival of original bedding, but is clearly due to movements in a plastic mass." Of the upper portion of the Lower Laurentian, known as Logan's Grenville series, Dr. Adams appears to think that the crystalline limestones and gneisses, while showing great dynamic action, are in all probability made up in part if not wholly of sedimentary material, often occurring in well defined bands or layers like the strata of later formations. But as regards the so-called Upper Laurentian, which embraces the Anorthosite or Norian series of Logan, his view is that their igneous and intrusive character is well established; and that while they frequently show a distinct and often a perfect foliation, they are but eruptive masses which have found their way upward by cutting the rocks of the fundamental gneiss and the Grenville series, in many cases being thrust between the bands or strata of the latter in directions of least resistance and having foliation induced in them under pressure while deeply buried and very hot.[5] The fact is however that there are many points upon which the authorities are not yet agreed, either as regards the origin, age, classification or nomenclature of the older rocks

The Laurentian system as defined by Logan.

Views of Van Hise

and Dr. Adams.

Successive systems and their origin.

For the present purpose it is enough to be assured that while there are large areas in which eruptive masses of granite and gneiss have penetrated

[4]Journal of Geology, vol. I., p. 115. [5]Ib. pp. 328-331.

the Huronian rocks and thrown them into folds, proving thus their later age, in general the reverse is the case—the Huronian resting unconformably on the Laurentian and being therefore of later origin; that the Cambrian, Silurian and Devonian systems are in regular order more recent than the Huronian; and that these successive systems of rocks have been built out of the ruins of the underlying ones.

In the course of secular cooling, it may safely be assumed, the crust of the earth became folded by contraction to form high mountains and deep valleys, and when after the lapse of long ages the temperature had fallen to the point at which water might form and accumulate the processes of degradation and upbuilding must have gone forward rapidly. The atmosphere, the rains and the hot waters became effective agencies in altering the physical features of the earth by erosion, and the fundamental rocks began to be covered by the sedimentaries. But the internal forces were active yet and for ages after; the mountain-making folding continued, and great masses of igneous rocks were intruded into the cooling crust or extruded upon it. The waters of the sea grew in volume, the Archæan highlands subsided, and once or twice in their history, if not oftener, they were over a very large extent submerged. In that sea the Huronian rocks—possibly a portion of the Laurentian also, and the foliated members of it certainly if they are sedimentary—were laid down, but we have no data for calculating their mass. The Huronians extended over large areas to the north and south, much of which is hidden by overlying deposits; in the typical region north of lake Huron their thickness was computed by Murray to be 18,000 feet, and their aggregate thickness as originally laid down may have been not less than 40,000 or 50,000 feet. At two successive periods in their history the rocks of this great system were folded and tilted into mountain forms, followed by two long periods of active erosion during which the denundation was deep enough to remove the entire series in places, and wear the mountains down to stumps. How far, if at all, glacial agencies operated in this cutting down and carrying away of Huronian material to construct new systems, there is no means of determining; but there is nothing improbable in the supposition that they were as active in those early ages of the earth as they have been in the later period, the record of which the ice has so left written upon the face of the rocks that we may read it. Huronian.

Following the Huronian system by the classification of the Canadian geologists, there come next in order the formations of the Cambrian system, embracing the Animikie, Nipigon and Potsdam, with an aggregate thickness of 54,000 feet according to some measurements, and of 63,000 feet according to others. The Nipigon alone has a thickness computed at 50,000 feet, composed almost wholly of gabbros, diabases, amygdaloids and lavas ejected through fissure and crater during a long period of volcanic activity, and resulting in the great east and west synclinal which forms the basin of lake Superior. Cambrian.

After the Cambrian rocks come those of the Silurian system with a thickness in lower Ontario of over 4,000 feet, and after these we have a few Silurian and Devonian.

formations of the Devonian with a thickness of 600 feet, the most recent of which are probably older than lake Huron, lake Erie or lake Ontario.

Relative ages of the systems.

Now from the close of the Laurentian system considerable areas of our so-called New Ontario have been dry land; and what length of time elapsed in the interval between the end of the Laurentian age and the deposition of the Chemung and Portage beds, which are the most recent of the lower Ontario formations, we may possibly conceive when it is ascertained that the aggregate thickness of the rocks is 18 to 22 miles. Or if we take only the period from the close of the Nipigon formation, during which fully three-fourths of the New Ontario was dry land, and all except the pre-Cambrian portion of lower Ontario was under the sea, we find that enough time had elapsed for the deposition of strata more than a mile in thickness. And that time must have been relatively long, as none of the rocks are of igneous origin; all are sedimentary.

Obviously therefore, when looked at from the geological point of view, the title of the New Ontario is something of a misnomer.

How does it appear when looked at in the light of modern history, of written documents and annals?

Its Human History.

Early settlements in southern Ontario.

There are few places in southern Ontario whose beginnings cannot be found within the limits of a century. Fort Frontenac, on the site of Kingston, was built in 1673, and Fort Rouille, on the site of Toronto, about 1750, and these were the only important posts in our part of the country during the French occupation. There were no settlements worthy of mention excepting those on the Detroit river until after Canada had been acquired by the British; and then the earliest were those formed by the loyalists at the close of the American war for independence. Kingston and Niagara were the first towns, and they date their origin from 1783. The first houses in Toronto were built in 1794, and the town plot of Hamilton was not laid out until 1813.

Posts of the fur traders in the north.

But in the New Ontario of the north the fur traders, both French and English, began active business more than two centuries ago, and many forts and posts were established throughout the region. The Hudson's Bay Company obtained its charter from Charles II. in 1670, and throughout the territory known as Rupert's land it was active and dominant for a period of two hundred years, or until the surrender of the territory to the Queen in 1869, at which time it occupied about twenty-five forts and trading posts within Ontario limits. Fort Albany, at the mouth of Albany river, was built by this company in 1683 or 1684, Henley House on the same river in 1744, and in 1730 a fort upon the Moose at or near where Moose Factory now stands. But the French traders were earlier on the field than the English, and for nearly a century they occupied a much larger extent of it. In 1673, the same year in which Fort Frontenac was built, they established two trading posts near the parallel of 50°, one on the Abitibi river and the other on the Missinaibi. The intrepid explorer, Daniel Dulhut, whose name is pro

served in Duluth, built a fort at the mouth of the Kaministiquia river in 1678, and called it Caministoygan; and before 1684 he built another far inland, the site of which is supposed to be at the foot of lake St. Joseph, on the northern boundary. The French also built a fort at the mouth of the Moose river in 1686, and a post at the foot of Abitibi lake before 1688. Their post at Sault Ste. Marie was established in 1670, three years before Fort Frontenac was built; and in 1731 they had reached the head of Rainy river, where La Verandrye built Fort St. Pierre, the ruins of which are yet visible under the shadow of stately trees, which have grown from seed to maturity since the time it was deserted.[6] The site of Fort St. Pierre, as well as that of Fort Frances, two or three miles below it, is one of the most beautiful in the New Ontario.

Rivalries of the French and English.

But with the loss of Canada the activity and enterprise of the French traders passed away, the blithe and hardy coureurs des bois were scattered, and for the next twenty years the Hudson's Bay Company enjoyed a monopoly of the trade in peltries with the Indians, saving the extent to which a few individual merchants and small companies in Montreal were able to send their agents and goods into the country.

The Northwest Company.

In 1783 however a new competitor arose when the Northwest Company was organized, and until the two companies united in 1821 their rivalry was a strife that broke out once or twice into war. The new company was composed largely of Highland Scotch merchants, and most of their officers and clerks and many of their employés were of the same nationality; but they also recruited into their service large numbers of the forest runners trained up in the palmy days of the old French traders. The enterprise of the company was shown by the construction of a canal at Sault Ste. Marie, which was open to navigation in the summer of 1800, being fifty-five years before the completion of the canal on the American side. It had also a shipyard at the beautiful sandy point a few miles above the falls known as Pointe aux Pins, once covered with red and white pine, the best of which were cut down and used for building the company's vessels for navigating the waters of lake Superior before the close of last century.[7]

Such instances of active enterprise no doubt go far to justify the belief expressed by Masson that had it not been for the quarrel of the Northwest Company with Lord Selkirk and the amalgamation with the Hudson's Bay Company in 1821, "the opening up of a line of communication between Canada and the Northwest Territories, and consequently the settlement of that country from Canada, would have been advanced by a quarter of a century." The interests of the Northwest Company, Mr. Masson says, were intimately bound up with those of Canada, while those of the Hudson's Bay

6 At the entrance of the river there is a rapid (Sir Alexander Mackenzie wrote in 1801) "below which is a fine bay, where there had been an extensive picketed fort and building when possessed by the French; the site of it is at present a beautiful meadow, surrounded with groves of oaks." Voyages from Montreal, p. lvi.

7 In the winter of 1770 Alexander Henry and his associates in a mining enterprise on the north and south shores of Lake Superior, built a barge fit for the navigation of the lake at their shipyard at Point aux Pins, and laid the keel of a sloop of forty tons; but it was not until August of 1772 that the sloop was launched.—Henry's Travels, pp. 226 and 284.

Sault Ste. Marie.

Company were in an entirely opposite direction.[8] So bright indeed seemed the outlook for Sault Ste. Marie at one time that it was pointed out as offering the best market for the farm products of the country around Toronto. "The soil in the neighborhood of York (Toronto) is said to be rich," John Johnston of the Sault wrote in 1809, "and the farmers could raise a vast quantity of provisions, were they encouraged by having a sure market for them. This could easily be accomplished by opening a communication with the Bay of Machedash, from whence to the Island of St. Joseph the distance is only ninety leagues. From the bay, a chain of islands extends to the northwest, of which St. Joseph is the last; these render the navigation perfectly safe, as you may either keep outside of them or between them and the shore, with safe anchorage everywhere. By this channel, provisions may be brought to St. Joseph, St. Mary and Michilimackinac in half the time and for half the expense they are procured from Sandwich, Detroit, etc., and the returns from the above places would arrive much sooner and safer at Montreal." Concerning the fortunes of Matchedash itself under this scheme, Johnston had not a doubt on his mind "but that it would soon become the most thriving place in Upper Canada, and the centre of provisions and transport trade for the fur countries."[9]

Fort William.

But the chief seat of the Northwest Company's enterprise was on the north shore of Lake Superior. Fort Charlotte, the place first selected, was at Grand Portage, at the mouth of Pigeon river. Fearing however that it might be within the United States boundary, a new location for business headquarters was chosen at the mouth of the Kaministiquia river and named Fort William, after William McGillivray, one of the partners of the company.[10] It soon became the most important post north of the great lakes,

[8] In Cauchon's memorandum it is stated that the Canadian Northwest Company were everywhere in advance of their rivals. "They were the first to spread themselves beyond the limits of the French, over the prairies of the Saskatchewan; they were the first to discover the great river of the north, now bearing the name of Mackenzie, and pursue its course to its discharge in the frozen ocean; they were the first to penetrate the passes of the Northern Cordilleras and plant their posts upon the shores of the Pacific; and with such indomitable energy did they carry on their business that, at the period of Lord Selkirk's interference, they had upwards of 300 Canadians, 'voyageurs,' employed in carrying on their trade to the west of the Rocky Mountains."

[9] John Johnston's Account of Lake Superior in Les Bourgeois de la Compagnie du Nord-Ouest, by L. R. Masson, vol. II.

[10] The first fort on this river was built by Dulhut in 1678, and it was re-built by La Noue under instructions from the French Government in 1717. The name Kaministiquia (which has undergone many modifications of orthography) is said by John Johnston to mean the "river of difficult entrance," and by Sir John Richardson the "river that runs far about," while Dr. Bigsby translates it "the river of the isles."

A further interesting narrative of how the seat of the fur trade on lake Superior came to be transferred from Fort Charlotte to Fort William is given by Dr. Bigsby: "During great part of the eighteenth century," Dr. B. writes, "before the union of the Indian traders into one company, the Northwest, the Lake Superior end of the Grand Portage was a pent-up hornets' nest of conflicting factions intrenched in rival forts. The traders first coalesced into two companies, one called the 'X. Y. Company,' from a mark placed on their packs, and consisting of Sir Alexander McKenzie and Messrs. Ogilvy, Richardson and Forsyth; and of the Northwest Company, at whose head were Messrs. W. and S. McGillivray, McTavish and others. Latterly both these firms united to contend with the old Hudson's Bay Company, acting under the charter of Charles the Second and later parliamentary sanction. The American Government, properly conceiving that the Grand Portage, the centre of so much commercial activity, was within their territory, signified about the year 1802, to the amalgamated company, now called the Northwest Company, their intention of imposing a duty of from twenty to twenty-five per cent. on all goods landed there. After having in vain offered a composition of five per cent., the Northwest Company abandoned the place, but not before they had well examined the Pigeon river from the north end of the Grand Portage down to lake Superior. Sir Alexander McKenzie occupied a long time in this task, accompanied by two Indians, but they found that high falls, rapids and shelving precipices

and at some seasons of the year the number of traders assembled there was not less than 3,000, gathered from all quarters of the Northwest to which the operations of the company had extended.

Councils and banquets of the Northwest Company at Fort William.

But Fort William was something more than the central depot for the exchange of furs and goods. It was the meeting place where the affairs of the company were planned every year between a few of the leading partners at Montreal and partners from the various trading stations in the wilderness. "Here, in an immense wooden building," to quote Washington Irving, "was the great council hall, as also the banqueting chamber, decorated with Indian arms and accoutrements, and the trophies of the fur trade. The house swarmed at this time with traders and voyageurs, some from Montreal, bound to the interior posts, some from the interior posts bound to Montreal. The councils were held in great state, for every member felt as if sitting in parliament, and every retainer and dependent looked up to the assemblage with awe, as to the house of lords. There was a vast deal of solemn deliberation, and hard Scottish reasoning, with an occasional swell of pompous declamation. These grave and weighty councils," Irving goes on to say, "were alternated by huge feasts and revels, like some of the old feasts described in Highland castles. The tables in the great banqueting room groaned under the weight of game of all kinds; of venison from the woods, and fish from the lakes, with hunters' delicacies, such as buffaloes' tongues and beavers' tails; and various luxuries from Montreal, all served up by experienced cooks brought for the purpose. There was no stint of generous wine, for it was a hard-drinking period, a time of loyal toasts, and bacchanalian songs, and brimming bumpers." [11]

A sketch by Washington Irving.

Neither Toronto, nor Niagara, nor Kingston could approach the commercial greatness of Fort William ninety years ago; and in no part of the interior of the lower peninsula were such scenes of activity to be witnessed as along the highways of trade in the interior of the northern country, from the Ottawa river to Lake of the Woods.

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rendered the river utterly impracticable for commercial purposes. The company then built their Fort William, and made the Dog river and other streams and lakes their road into the Northwest fur countries, although this is inferior in every respect to the old route, so much so, that the voyageurs had to be coaxed and bribed into the use of it. I am obliged to Mr. Astronomer Thompson for this information."—The Shoe and Canoe, or Pictures of Travel in the Canadas, by John J. Bigsby, M.D., vol. ii., pp 240-1.

[11] Irving's Astoria, p. 8 (Bohn's edition). The X. Y. Company, which was a section of the Northwest Company, was detached from it in 1796 but re-united with it in 1801, and had its headquarters at Grand Portage. The mode of living there is described as follows by Sir Alexander Mackenzie (Voyages from Montreal, p. xlvi): "The proprietors, clerks, guides and interpreters mess together, to the number of sometimes an hundred, at several tables, in one large hall, the provision consisting of bread, salt pork, beef, hams, fish, and venison, butter, peas, Indian corn, potatoes, tea, spirits, wine, etc., and plenty of milk, for which purpose several milch cows are constantly kept. The mechanics have rations of such provision, but the canoe-men, both from the north and Montreal, have no other allowance here, or in the voyage, than Indian corn and melted fat. The corn for this purpose is prepared before it leaves Detroit, by boiling it in a strong alkali, which takes off the outer husk; it is then well washed, and carefully dried upon stages, when it is fit for use. One quart of this is boiled for two hours, over a moderate fire, in a gallon of water; to which, when it has boiled a small time, are added two ounces of melted suet; this causes the corn to split, and in the time mentioned makes a pretty thick pudding. If to this is added a little salt (but not before it is boiled, as it would interrupt the operation), it makes a wholesome, palatable food, and easy of digestion. This quantity is fully sufficient for a man's subsistence during twenty-four hours, though it is not sufficiently heartening to sustain the strength necessary for a state of active labour. The Americans call this dish hominee." In a foot note Sir Alexander adds that corn is "the cheapest provision that can be procured, though from the expense of transport the bushel costs about twenty shillings stirling at the Grand Portage. A man's daily allowance does not exceed tenpence."

Routes from lake Superior to the Northwest.

From lake Superior there were two routes to the Northwest; one from Grand Portage through the boundary waters to Rainy lake; and the other up the Kaministiquia river and Dog lake, across the long portage to Savanne river, and thence through Lac de Mille Lacs and a succession of smaller lakes, down the Maligne and Meccan or Namakan rivers into Rainy lake. The latter was the route usually taken by the Northwest Company's traders; and from the pen of R. M. Ballantyne, who came over it on his way from Norway House to Montreal in 1845, we have a graphic picture of the scenes that must have been witnessed along those waterways for well nigh forty years, covering the close of the eighteenth and the beginning of the nineteenth century. "Many years ago, in the time of the Northwest Company," Ballantyne writes, "the echoes among these wild solitudes were far oftener and more loudly awakened than they are now. The reason of it was this. The Northwest Company, having their headquarters at Montreal and being composed chiefly of Canadian adventurers, imported their whole supplies into the country and exported all their furs out of it in north canoes by the same route over which we now travelled. As they carried on business on a large scale, it may be supposed that the traffic was correspondingly great. No less than ten brigades, each numbering twenty canoes, used to pass through these scenes during the summer months. No one who has not experienced it can form an adequate idea of the thrilling effect the passing of these brigades must have had upon a stranger. I have seen four canoes sweep round a promontory suddenly and burst upon my view, while at the same moment the wild, romantic song of the voyageurs, as they plied their brisk paddles, struck upon my ear; and I have felt thrilling enthusiasm on witnessing such a scene. What then must have been the feelings of those who had spent a long, dreary winter in the wild northwest, far removed from the bustle and excitement of the civilized world, when thirty or forty of these picturesque canoes burst unexpectedly upon them, half shrouded in the spray that flew from the bright vermilion paddles, while the men, who had overcome difficulties and dangers innumerable during a long voyage through the wilderness, urged their light craft over the troubled water with the speed of the reindeer, and with hearts joyful at the happy termination of their trials and privations, sang with all the force of three hundred manly voices one of their lively airs, which rising and falling faintly in the distance as it was borne, first lightly on the breeze, and then more steadily as they approached, swelled out in the rich tones of many a mellow voice and burst at last into a long, enthusiastic shout of joy. Alas!" Mr. Ballantyne exclaims, "the forests no longer echo to such sounds. The passage of three or four canoes once or twice a year is all that breaks the stillness of the scene; and nought save narrow pathways over the portages, and rough wooden crosses over the graves of the travellers who perished by the way, remains to mark that such things were."[12]

A pen picture from Ballantyne.

[12] R. M. Ballantyne's Hudson's Bay, pp. 279-80. As descriptive of the kinds of canoes used by the fur traders, Mr. Ballantyne says: "A number of canôtes de maitre, or very large canoes, are always kept in store here [Fort William] for the use of the Company's travellers. These canoes are of the largest size, exceeding the north canoe in length by several feet, besides being much broader and deeper. They are used solely for the purpose of travelling on lake Superior, being much too large and cumbersome for travelling with through the

Such was our new Ontario under the regime of the trading companies; it had an early beginning as compared with the Ontario of the south; but the stronger of the companies absorbed or devoured the weaker, and while large profits were earned the country was not in the faintest degree bettered in the end by their operations. It had always indeed been the policy of the Hudson's Bay Company to keep up the primeval state of the forest, as the founding of settlements was incompatible with the life of the fur trade. Moreover, history teaches the lesson that a company organized with powers of government and exclusive rights to carry on trade in a country has for its first consideration the commercial idea, and everything else is subordinate. The Hudson's Bay Company had no other thought for the two centuries during which it held sway in northern Canada than how the largest dividends could be earned for the shareholders. So it was with the English East India Company, whose over-ruling hand was felt in India for more than two and a half centuries, down to the close of the Mutiny. And so we have just seen it to be with the British South Africa Company, whose filibustering raid into the Transvaal came perilously near to plunging Europe into war. The Hudson's Bay Company relinquished its authority over the territory of northern Ontario—the portion of it beyond the height of land—in 1869; but it took twenty years to settle the disputes which arose afterwards between the Dominion and Provincial Governments as to the true boundaries and the ownership of the land, timber and minerals. Therefore it is only since 1889, when the limits on the north and west were determined by Imperial Act, that settlers, lumbermen and mining prospectors have been sure of titles over a large extent of the region. And this is why it is called the New Ontario.

The commercial idea paramount with trading companies.

PHYSICAL ASPECTS OF THE COUNTRY.

The physical features of the country cannot be accurately described yet, because they are not sufficiently known. There is a height of land extending westward from the Quebec boundary as far as the 90th meridian, which forms the watershed between Hudson bay and the great lakes. There is another, running northward near the 90th meridian from the American boundary to the 50th parallel, and then turning north westward between lake St. Joseph and lake Seul, enters Keewatin territory and reaches Hudson Bay near the mouth of Nelson river.

Watersheds and river systems.

The first of these watersheds to the north includes the basin of the Moose river, with its three large tributaries, the Abitibi, the Metagami and the Missinaibi; and a portion of the basin of the Albany river, with the Kenogami as its chief tributary from the Ontario side.

Moose river basin.

South of the watershed are numerous rivers flowing into the St. Lawrence system of waters, including the Montreal, which joins the Ottawa; the French, which drains lake Nipissing and its tributaries, and lake Wahnapitae

St. Lawrence river basin.

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interior. They are carried by four men instead of two, like the north canoe; and, besides being capable of carrying twice as much cargo, are paddled by fourteen or sixteen men. Travellers from Canada to the interior generally change their canôtes de maitre for north canoes at Fort William before entering upon the intricate navigation through which we had already passed; while those going from the interior to Canada change the small for the large canoe." pp. 287-8.

through a river of the same name, into Georgian bay; the Whitefish, Spanish, Mississaga and Thessalon, into lake Huron; and a number of rivers into lake Superior, the largest of which are the Goulais, Michipicoten, White, Pic, Nipigon and Kaministiquia.

Lakes with double outlets.

The headwaters of those streams flowing north to Hudson bay and south to the great lakes often interlace each other, and there are a number of lakes on the tableland which discharge their waters both north and south. Shoal lake, northeast of lake Nipigon, is one of these. It is 300 feet above the level of lake Nipigon, to which it sends a contribution of its waters down the Ombabika river, and 1,200 feet above the level of the sea, to which an equal contribution is made through the channels of the Powitic and Albany rivers. "No portage occurs on the Ombabika for about nine miles before reaching Shoal lake," Dr. Bell reports, "nor for nearly five miles beyond its northern outlet; so that we passed the height of land with the greatest possible ease, having had about seventeen miles of uninterrupted canoe navigation from the time we made the last portage on the southern side till we came to the first in going down on the northern."[13] Lake Temagami, which lies about thirty miles north of the west end of lake Nipissing, is remarkable for having had at one time four outlets; but since its level has fallen the number is reduced to two—the Metabechawan river to the Ottawa, and the Sturgeon to lake Nipissing. By these lakes along the northern divide and the streams which discharge their waters, Ontario is found to be cut up into a number of islands, the largest of which is the one we occupy.

Nelson river basin.

The portion of the Province west of the north and south watershed, near the 90th meridian, lies within the basin of the Nelson river, which, next to that of the Mississippi, is the largest river basin on the continent. Lake Seul in the north, Rainy lake in the south, and Lake of the Woods in the west collect the Ontario waters of this basin to discharge them through Winnipeg river into the lake of that name, there to mingle with the waters of Red river from the highlands of Minnesota and of the Saskatchewan from the Rocky mountains, and be borne by the mighty Nelson into Hudson bay.

Lake Agassiz.

In the closing period of the glacial age, as the ice field slowly retreated towards the arctic circle, the region towards which those streams from the eastern, southern and western slopes converge became the bed of what was no doubt the largest fresh water lake ever formed upon this earth. Lake Agassiz, for that is the name by which it is now known, is traced as to its shore lines by well defined gravel and sand beaches from the height of land in Minnesota northward to the 55th parallel, and at least from Rainy lake, if not from lake Seul, west to the Souris river. The area of this lake is computed to have been 110,000 square miles, or about 15,000 square miles larger than the combined areas of the lakes Superior, Michigan, Huron, Erie and Ontario.[14] The valley of Rainy river, as well as the plains of Minnesota, Dakota and Manitoba, owe their fertility to the silt deposited in this ancient lake; and it is not unlikely that we owe to its action also, to some extent, the

13 Geol. Sur. Can., 1871 2, p. 107.

14 Warren Upham in Can. Geol. Sur., 1888-9, p. 11E.

deeply indented shore lines of Rainy lake and Lake of the Woods, which promise to aid in the development of the resources of the country bordering upon them by the facilities they offer to an extended navigation.

A land of lakes and rivers.

But like every country over which the glaciers moved, the whole north is a land of lakes, and so throughly is it threaded by streams running into and out of the labyrinth of lakes that the skilled woodsman with his canoe may steer his way in any course at his will. Many of the lakes, too, are of rare beauty, with clear blue waters and studded with lovely islands, of which Temagami, Crow, Shebandowan, Greenwater and Baril are fair types. Temagami lake, 600 feet, and Crow lake, 800 feet deep, are among the most picturesque in the world. Of rivers also there is an infinite variety, of all breadths and lengths and colors; and even in the same stream one may discover every shade of change. For miles together it may be level and placid as a stretch of canal. Then the rocky banks are seen tc contract, the current becomes a rapid, and presently expands into a lake. Or there are shallows, a maze of channels through islets clothed with spruce or cedar, a terraced fall, a swirl of eddies, a rush of the foam-flecked flood between walls of rock, with the almost constant lakelet or lagoon in a setting of dark woods beyond, where in a margin of grass or reeds—

> The lotus lolls on the water,
> And opens its heart of gold,
> And over its broad leaf-pavement
> Never a ripple is rolled.[15]

A typical canoe route.

And so the rounds of change go on through shifting scenes of quiet and turbulence. Such a river is the Seine, which, flowing out of Lac des Mille Lacs, carries down in its tortuous way to Rainy lake the overflow of a thousand other lakes besides. A canoe trip starting from Savanne on the Canadian Pacific Railway, traversing Lac des Mille Lacs, Baril, Brule, Windigoostigwan, Elbow and Crooked Pine Lakes, and thence down current on the Atik-okan and Seine rivers to Rainy lake, and on, if one is in the mood, across this lake to Fort Frances, down the Rainy river to Hungry Hall, and over Lake of the Woods to Rat Portage, where the Canadian Pacific Railway is reached again,—this is an outing as replete with interest and exhilaration, and offers as much in the way of adventure, as the heart of any lover of nature can desire. Especially so if it is taken late in the summer or early in the autumn, when the poplar woods are beginning to golden, and the mountain ash is laden with red-ripe clusters of berries, and the career of the pestilent black fly is over and gone for the season.

The Hudson bay slope.

The information we possess of the Hudson Bay slope is practically limited to what has been seen along the rivers, for it is doubtful if any white man has yet crossed that country from east to west north of the 49th parallel. The general impression is that a large portion of the basin of Moose river is a treeless waste, covered with peat bogs, and not likely to have any agricultural value. But until more is known of it than any traveller or explorer has yet learned by canoeing up and down the chief rivers, with here and there an excursion of one or two miles into the timber out from their banks, it is useless to speculate on the future of this region.

15 From Cleopatra, by W. W. Story.

A large tract of rich and well-timbered land on the Quebec side.

The discovery of what appears to be a most valuable tract of country on the Quebec side, east of the Moose river basin, has only been made known to us during the past year. By the explorations of Henry O'Sullivan, of the Crown Lands Department, Quebec, and of Dr. Robert Bell, of the Geological Survey, it has been ascertained that in the basin of the Nottaway river and its tributaries, the Waswanipi and the Mekiskan or Bell, there is a tract of rich and finely-timbered land as large in extent as the whole of England, of which nothing whatever was known two years ago. The description given of it in Mr. O'Sullivan's report, recently published, is intensely interesting to every Canadian, as well as to students of physical geography, and inspires us with the hope that regions of perhaps equal extent and value may be found in Ontario also, beyond the height of land. We shall only know by exploring for it, as has been done in Quebec. The Hudson's Bay Company, whose only interest is in the fur trade, we can depend will never tell us any good thing of the country which might have the effect of inviting the settler, the miner or the lumberman to disturb the haunts of the Indian trapper and hunter.[16]

Physical Characteristics and Natural Resources.

Geological systems of the region.

After the account already given of the Archæan rocks of the New Ontario, it is not necessary to write more than a few words on its geology. Belts of the Huronian system of rocks, running generally in a northeast and southwest direction, overlie the Laurentians all the way from Lake of the Woods to the Ottawa river, and extend to the southern limits of the territory along the international boundary and the shores of lake Superior and lake Huron. What is known as the "great belt" of this system stretches from lake Superior north of lake Huron to lake Mistassini in Quebec, a length of about 700 miles. Around lake Superior there are Cambrian rocks (of the Animikie and Nipigon series) overlying the Huronian, and it is thought also that there is an area of Lower Cambrian north of lake Huron, in the basin of the Vermilion river, the length of which is thirty-six miles and the greatest breadth 8 miles. Around Sault Ste. Marie is a formation of red sandstone which is believed to be of Potsdam age; west and northwest of lake Temiscaming is an important area of Niagara limestones; while on the Hudson Bay slope, lying up over the Laurentian and Huronian rocks and

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16 In the report of his explorations, dated 15th May, 1895, Mr. O'Sullivan says: "The general impression, formed no doubt from the experience of surveyors and explorers in this Province, was that all that northern region was a cold rocky waste, and certainly any one who would visit the head waters of any of our large rivers flowing into the St. Lawrence from the north would naturally be impressed with the feeling that there was little use in searching for anything worth having, excepting perhaps fish, game and minerals, any farther north, and I must confess that this was my own impression until last summer. On St. Jean Baptiste day, 24th June last (1894), the Reverend Father Gueguin said mass in my tent at the foot of lake Dumoine. That reverend gentleman has been missionary among the upper Ottawa and Hudson bay slope Indians for nearly thirty years. After mass, as we were descending the Dumoine river in company with Mr. L. A. Christopherson, Father Gueguin, in relating some of his experience among the Indians, told me of having seen some good land and large timber in the neighborhood of lake Waswanipi, and strongly advised me to try and explore that country. Mr. Christopherson, guardian of the Hudson's Bay Company's post at Grand Lake Victoria for the last twenty years, was of a different opinion. He said that he did not think there was anything worth having beyond the height of land. To use his own words. 'The interior Indians who visited the post could not get an axe-handle there.'" This is in keeping with the traditional policy of the Hudson's Bay Company.

extending from the eastern boundary of the Province westward beyond the Kenogami river, are several formations of the Silurian and Devonian systems, including the Niagara, Onondaga and Corniferous rocks. In the region southwest of James bay, Dr. Bell says, the Corniferous formation occupies an area larger than all the western peninsula of Ontario.

Resources of the forest.

Of all the natural resources of the New Ontario the forest is the one of most obvious value, for there is nothing to hide or obscure it. There are yet wide tracts of pine land, although many square miles have been cut over by the lumberman and more have been swept and destroyed by fire. It seems likely that most of the country now covered with poplar was one time under pine. West of Port Arthur the pine forest was burnt over within the memory of men yet living. In his Narrative of the Red River Expedition of 1857 Prof. Hind says he found extensive areas covered with burnt forest trees, chiefly of pine, in the valley of the Kaministiquia river as far as Little Dog lake, where the formidable barrier of Great Dog lake comes into view. On Dog river he observed wide areas strewed with the blackened trunks of trees; and in the young forest which seemed fresh and green at a distance, "the ground was found to sustain the charred remains of what had once been a far more vigorous vegetation."[17] And of the country beyond Lac des Mille Lacs he writes: At Brulé portage [between Baril and Brulé lakes] I ascended a steep hill bordering a small rapid stream called Brulé river, and from an altitude of fully 200 feet had a fine view of the surrounding country. The vegetation upon the hillside and summit was truly astonishing, and the term Brulé portage received an unexpected interpretation on finding hidden by a rich profusion of brushwood the dead trunks of many noble pines Throughout the day the tall trunks of white pine, branchless and dead, rising in clumps or in single loneliness far above the forest, had attracted attention, and on the side of the Brulé hill we observed many prostrate half-burnt trees of the largest size. One dead trunk was measured and found to be twelve feet in circumference five feet from the ground. A living tree, tall, clean and apparently quite sound, measured nearly ten feet in circumference, and many of the prostrate pines were of equal dimensions. There can be little doubt that these were the remains of a magnificent white pine forest, which formerly extended over a vast area in this region, since from the summit of the hill the forms of scattered living trees, or tall branchless and scathed trunks met the eye in every direction. The young second growth indicated a soil not incapable of sustaining pine trees of the largest proportions; black cherry, birch (both white and black), alder, small clumps of sugar maple, and a thick undergrowth of hazelnut now occupies the domain of the ancient forest. The southwest side of this hill formed a precipitous escarpment 150 feet above the waters of a long, clear lake. All around the eye rested upon low dome-shaped hills dipping towards the northeast and covered with a rich profusion of second growth. The vast wilderness of green was studded with black islands of burnt pine, and a few isolated living trees, serving by their surprising dimensions to tell of the splendid forest which must have once covered the country. . . The uniform size of

Evidences of devastation by fires.

[17] Vol. I., p. 49.

second growth timber on the Brulé hill seemed to prove that the great fire which devastated this region may have occurred about thirty years since." That would be about seventy years ago. Another fire which destroyed a valuable pine forest occurred about twenty-five years ago in what is now known as the Sudbury country, north of lake Huron. It is said that in one day this fire ravaged a tract seventy miles long by thirty wide, or in all about 2 000 square miles.[19] The same region, Indian tradition says, was burnt over about one hundred and thirty years ago. Indeed it is very probable that successive forests have grown up and have perished in the flames in past milleniums, since the land became fitted for the sustaining of tree life upon it. Hitherto little use has been made of timber other than pine, of which there are immense areas in the New Ontario; but it is certain to find a market, and the Province will yet derive a large revenue from it. Even now there is an active demand for poplar and spruce for the manufacture of pulp, and this is fast becoming an industry of great magnitude. As for the future, one hardly dares trust himself to forecast what our needs may be a century or a quarter of a century hence, for the wit of man is seeking out many inventions. But in all human probability we shall never be able to find a complete substitute for wood in the arts; and it is not too early now for adopting schemes to conserve our forests. There are many parts of the north so rough and rocky as not to possess any prospective value for agriculture, but suitable enough for forest growth. What better policy can be chosen as regards such tracts than to set them apart in perpetuity as Crown forests? This is a simple plan, and it possesses the merit of being well started already, in the sense that Nature has planted the trees and prospered their growth under its own conditions.

The conservation of forests.

Agricultural capabilities of the new Ontario.

As an agricultural country, there is much to be said for the north. It is true, as just stated, that many parts are too rough and rocky for tillage; but other parts are as full of promise as any of our older counties. This is especially true of the river valleys north of lake Huron, where the soil is wonderfully productive. And there are many other areas of equal excellence, such for example as the regions around lake Temiscaming (where twenty-five townships embracing 575,000 acres are surveyed), to the north and west of

[18] Hind's Narrative, vol. I, pp. 63-64.

[19] The first fire in this region occurred in 1864, and extended from lake Nipissing to Bruce Mines along the shores of Georgian bay and lake Huron. The fire of 1871 followed in the wake of the previous one, but covered a much larger area in the interior. Mr. D. F. Macdonald of Parry Sound, who knows the region intimately, writes me: "The hardwood ridges and dense swamps seemed to be the only effective barriers of the conflagration. Lakes and rivers made no break in the fiery torrent as it rushed along the pine-clad and moss-covered ridges of rocks and sandy or gravelled plains. The fire of 1871 was doubtless the fiercest, as it destroyed every tree and plant in its course, as well as animals. I found the charred bones of an Indian on the Wahnapitæ river in the autumn of 1872, and no doubt he had been smothered in the smoke and flames. The burnt barrel of his gun, his hatchet, knife and kettle, with the metallic buttons of his clothes and a few wrought iron nails from the canoe, were all commingled with his charred bones. This shows that the fire was heavy and hot when an Indian would become a victim to its ferocity. Had he followed the river he would have been swept over the falls; he ran the fiery gauntlet about half way across the portage with the canoe on his shoulders, when he fell smothered with smoke and heat and was cremated on the spot. Both fires originated in the neighborhood of lake Nipissing, and in 1871 there were no persons on that lake except John Beatty at the mouth of South river, and Norman McLeod, the Hudson's Bay trader, near the mouth of the Sturgeon, and a few Indians on the Beaucage reserve, on Goulais point, and at the Chaudiere falls." The fire of 1864 took place in the first week in May, Mr. Samuel A. Marks of Bruce Mines informs me. Only five houses were saved in the Copper Bay section of the village, and about 1,500 people were left homeless.

lake Nipissing, and in the valley of the Vermilion river. For the growth of peas and oats, timothy and clover, and root crops of all kinds, there is no more suitable land anywhere than in those districts; and they are equally well adapted for the dairy industry and the production of beef and mutton, as the pastures are nourishing and water abounds everywhere. Beyond Port Arthur and Fort William there are many good farms, and on the Wabigoon river, 200 miles from Fort William, there is a tract of land now being opened for settlement, where the Ontario Government has already established a dairy farm, which promises remarkably well. No doubt many other regions of fertile land exist throughout our northern domain; but of those that are well known it may be safe to say that the largest and best is the country on the Rainy river lying between Rainy lake and the Lake of the Woods. Writing of this district and the river itself in his Narative of a Journey round the World, Governor Simpson of the Hudson's Bay Company said: "From Fort Frances downwards, a stretch of nearly a hundred miles, it is not interrupted by a single impediment, while yet the current is not strong enough naturally to retard an ascending traveller. Nor are the banks less favorable to agriculture than the waters themselves to navigation, resembling in some measure those of the Thames near Richmond. From the very brink of the river there rises a gentle slope of green sward, crowned in many places with a plentiful growth of birch, poplar, beech, elm and oak. Is it too much for the eye of philanthrophy to discover, through the vista of futurity, this noble stream, connecting as it does the fertile shores of two spacious lakes, with crowded steamboats on its bosom, and populous towns on its borders?"[20] This is a glowing description for a Hudson's Bay officer to give; but Governor Simpson recanted it with ingenuity when the claims of his company seemed to be in jeopardy before a committee of the Imperial House of Commons a few years afterwards. When the passage from his book was read to him, first by Mr. Gordon and subsequently by Mr. Roebuck, Governor Simpson said he only meant the description to apply to the bank, "the lip of the river" as he phrased it. "The back country is a deep morass, and never can be drained, in my opinion." And again: "I confine myself to the banks; the back country is one deep morass extending for miles." The Governor's explanation was ingenious in a little sense, but it had the demerit of being untrue. The fertile land along the Rainy river on the Ontario side extends nearly from one lake to the other, a distance of about eighty miles, and its breadth is said to range from five to twenty-five miles. The land also rises steadily towards the north, so that drainage is easy; indeed the swampy ground a mile back from the river is found by levels to be seventy feet above it. The soil is deep and rich, and the climate is favorable for the maturing of almost every kind of cereal grown in lower Ontario. Ballantyne, who ascended the river on his way from Norway House to Montreal, as previously noted, has given us his impressions of it in a book published long after he had left the service of the Hudson's Bay Company. "Next morning [September 11, 1845] we commenced," he writes, "the ascent of Lac la Plaie river. This is decidedly the

The Rainy river district.

Governor Simpson's testimony and

his ingenious recantation.

Real character of the land.

[20] Narrative of a Journey Round the World during the years 1841 and 1842, vol. 1, pp. 45 6.

Ballantyne's testimony.

most beautiful river we had yet traversed—not only on account of the luxuriant foliage of every hue with which its noble banks are covered, but chiefly from the resemblance it bears in many places to the scenery of England, recalling to mind the grassy lawns and verdant banks of Britain's streams, and transporting the beholder from the wild scenes of the western world to his native home. The trees along its banks were larger and more varied than any we had hitherto seen,—ash, poplar, cedar, red and white pines, oak and birch being abundant, whilst flowers of gaudy hues enhanced the beauty of the scene."[21] This is almost a true picture, but settlement now extends along many miles of the river on the Ontario side, and to some extent at least the forms of natural beauty have been changed and marred. The description however is remarkably faithful of the Minnesota side, where, except for glades with wide-branching elms and a few gaps cut by squatters, the banks are yet clothed with the primeval forest.[22]

Extent and value of the country's mineral wealth.

But the best hopes for the New Ontario are no doubt built upon its mineral wealth, the extent and value of which we are only beginning to realize. The rocks of the Huronian and Cambrian systems are found to be mineral-bearing over a wide extent; and from the number of discoveries made every year in new and unexpected localities, we have an assurance that as yet only a little of this hidden treasure has come to be known.

Silver.

In the Animikie slates of the Cambrian system silver mines have been worked at points far apart, some of which have proved to be very rich. Silver Islet alone has yielded upwards of $3,000,000. In the Nipigon rocks of the same system native copper and copper sulphide have been discovered at many places, but notably on Michipicoten island and point Mamanise, where the occurrences are the same as on Keweenaw point on the south shore.

Copper, nickel and cobalt.

But too much of the exploratory work hitherto has been extravagantly done, both on the island and the mainland. As an illustration, it may be stated that the Quebec Mining Company in 1848 50 expended at Point of Mines $232,256, chiefly above ground, before any quantity of ore was raised or the lodes were proved to be valuable. A village of fifty or sixty houses was built for miners and other employés, besides offices, stores, magazines and a sawmill. Inspector William Gibbard, who visited the location in 1860, reported that

[21] R. M. Ballantyne's Hudson's Bay, p. 272.

[22] In his Voyages from Montreal, p. lvi, Sir Alexander Mackenzie says of the Rainy river and the country along its banks: "This is one of the finest rivers in the Northwest, and runs a course West and East one hundred and twenty computed miles; but in taking its course and distance minutely I make it only eighty. Its banks are covered with a rich soil, particularly to the North, which, in many parts, are clothed with fine open groves of oak, the maple, the pine, and the cedar. The Southern bank is not so elevated, and displays the maple, the white birch and the cedar, with the spruce, the alder, and various underwood. Its waters abound in fish, particularly the sturgeon, which the natives both spear and take with drag-nets. But notwithstanding the promise of this soil, the Indians do not attend to its cultivation, though they are not ignorant of the common process, and are fond of the Indian corn, when they get it from us. Though the soil at the foot is a stiff clay, there is a garden, which, unassisted as it is by manure, or any particular attention, is tolerably productive." Dr. Bigsby, who went down the Rainy river in 1823, makes this reference to it in his book, Shoe and Canoe: "A thousand years ago, while yet our England was a wolfish den, the silver Trent of the midland counties must have greatly resembled the Lapluie of the present day. I am not sure that the fur trader, an Italian perhaps, had not a hut on its banks; but certainly at the time we are speaking of both these streams flowed smoothly and freely in a succession of lovely and sequestered reaches, and through terraced meadows, alternating with rich woods and reedy marshes. The Lapluie seems made for a pleasure excursion; all is serenity and beauty." Vol. II., p. 270.

he found smelting works, crushing mills, jigging works, stamp forges, railroads, hundreds of yards of iron chain, ladders, furnaces, scows, etc., in a dilapidated state, thousands of fire brick, and an expensive conduit about one mile long made to convey water to the stamps.[23] This was expenditure preparatory to mining, before it had been proven that there was more than a surface show of ore; and the capital being thus wasted the company was left without means to carry on the actual work of mining or establish the value of their property by sinking deep shafts upon the veins.[24] It is however in the Huronian system of rocks that the greatest variety of minerals is to be found. Ores of copper, nickle, iron, gold and other metals have been discovered, and operations are carried on which promise to establish a large industry. At the Bruce and Wellington mines, north of lake Huron, copper mining was carried on for about 27 years, ending with 1875, and the value of the output in that time is reported to have been as much as $7,000,000. At the Sudbury mines, the ores of which yield nickle, copper and some cobalt, the total ore output of the mines for the six years 1890-95 was 539,936 tons, of which there was smelted and reduced to matte in the furnaces 430,539 tons. For five years 1891-95 this industry paid for labor at the mines and works the large sum of $1,436,216; and the value of the products of nickle, copper and cobalt for the four years 1892-5, computed at the selling price at the furnaces, was $2,781,800, or an average of $695,450 a year. Iron ore has been found in many localities in the Huronian formations, but the largest and most valuable deposits are believed to be the hematites of the Mattawin

Bruce and Wellington mines

Sudbury mines.

Iron

[23] Report of the Commissioner of Crown Lands of Canada for 1864, p. 99.

[24] In 1767 and 1768 the east shore of lake Superior was explored by Alexander Henry and copper was discovered at a number of points from Mamainse head and to Michipicoten harbor, which was called by the Indians the coast of Nanibojou. In the spring of 1768 Mr. Henry met Alexander Baxter, his partner, to whom he communicated the information of his discoveries, and measures were taken for working the mines. In 1770 Mr. Baxter returned from England, bringing with him papers by which, with Mr. Bostwick and himself, Mr. Henry was constituted a joint agent and partner for working the mines. They passed the winter together at Sault Ste. Marie and built a barge fit for the navigation of the lake, besides laying the keel of a sloop of forty tons. In May, 1771, they went to explore the island of Yellow Sands (Caribou island) where they hoped to find gold, but a stay of three days did not enable them "to find gold, nor even the yellow sands." On the fourth day they sailed to the east shore, examined the coast of Nanibojou where they found several veins of copper and lead, and returned to Point aux Pins, where they erected an air furnace. The assayer made a report on the ores, stating that the lead ore contained silver in the proportion of forty ounces to the ton, and the copper ore only in very small proportion. The rest of the season and the following winter and spring were passed in exploring and mining at Ontonagon on the south shore; but in June the whole establishment of miners returned to Sault Ste. Marie. "In the following month of August," Henry records, "we launched our sloop, and carried the miners to the vein of copper ore on the north side of the lake. Little was done during the winter; but, by dint of labor performed between the commencement of the spring of 1773 and the ensuing month of September, they penetrated thirty feet into the solid rock. The rock was blasted with great difficulty; and the vein, which at the beginning, was of the breadth of four feet, had in the progress contracted into four inches. Under these circumstances we desisted and carried the miners back to the Sault. What copper ore we had collected, we sent to England; but the next season we were informed that the partners there declined entering into further expenses. In the interim, we had carried the miners along the north shore as far as the river Pic, making, however, no discovery of importance. This year therefore, 1774, Mr. Baxter disposed of the sloop and other effects of the company, and paid its debts. The partners in England were his Royal Highness the Duke of Gloucester, Mr. Secretary Townshend, Sir Samuel Tutchet, baronet, Mr. Baxter, consul of the Empress of Russia, and Mr. Cruickshank: in America, Sir William Johnson, baronet, Mr. Bostwick, Mr. Baxter and myself. A charter had been petitioned for and obtained; but, owing to our ill success it was never taken from the seal office." Travels and Adventures in Canada, by Alexander Henry, pp 234-5. This was no doubt the earliest attempt at mining made by white men on the Canadian shore of lake Superior.

river range and the magnetites of the Atik-okan. Both these are of immense extent; in fact the ore is in mountainous bodies, and millions of tons could be mined as in an open quarry. But for the present they lie far from railways, and the home market is only opening. Gold however is found more generally than any of the other metals. It has been discovered in the Sudbury district, in the townships along the valley of the Thessalon river, on the north shore of lake Superior, and in many places throughout that part of the Province which lies within the basin of Nelson river. This latter district embraces Lake of the Woods and Rainy lake and the territory drained by their tributary rivers, as well as a portion of the slope drained by the English river, and is 200 miles long by 100 broad. The discoveries made here within the last three years have raised great expectations, and some of the properties upon which development work has been done are confidently asserted to be rich and valuable. There are now six stamp mills in that country for treating gold ore, with an aggregate capacity of 60 stamps, and more are likely to go up this year if the needed capital is got. Those northern goldfields are certainly as well deserving of the attention of miners and capitalists as many in the United States, in Russia, or in Australia. But the production of bullion in large and paying quantities seems to be needed to establish confidence in them, and this work remains to be done.

Gold.

General Conclusions.

Enough has been said of the New Ontario as regards its extent, its physical characteristics and natural resources to prove that it is an important possession; and it is humbling to our pride as men of an enterprising and progressive race to confess that so little has been done to occupy and utilize it. Fifteen years ago (in 1881) it had seven organized municipalities, with a population as taken by the assessors of 4,765. In 1895 it had forty-eight municipalities, and a population of 36,000. This is some progress, but it ought to be far more. There are more men leaving our Province every year than is represented by the increase of those fourteen years, and it may well be doubted if they have gone to a better country for improving their circumstances. The two things most needed to open up the New Ontario are population and capital. British capital and emigration are turned towards the United States, in many parts of which a British citizen cannot hold a foot of ground in his own name; and towards the Transvaal, where he has no civil rights, and pays the great bulk of the taxes without even the privilege of educating his children in the schools in his own tongue. He could depend on getting fair treatment and the security of all the rights of citizenship if he came to the New Ontario instead, and he might find there scope for all his energies.

Little done to occupy and utilize our possession.

Slow growth of population.

Relative advantages of the New Ontario.

But it is an old saying that the gods help those who help themselves. If we take a proper interest in the north country ourselves we may do much to turn it to a good account. We do not lack for men or capital. Our men in

far too large numbers cross over to the United States to swell the population of that country. Much of our capital is in the banks. The official statement for the month ending 31st December last shows that there was deposited by the public in the chartered banks of Canada the very large sum of $187,119,573, whereof $119,667,176 is presumably drawing a low rate of interest, it may be 3 or possibly 3½ per cent., while $67,452,397 is at call, drawing none. There must be openings in the New Ontario for investing a portion of this capital with a chance of realizing good profits; and every investment of this nature THERE is patriotism, as well as enterprise and pluck; by which I mean a real investment, where there is some risk of loss as well as of gain, not a loan upon a gilt-edged mortgage. Ought not the policy to be, That we ourselves possess the land and win its wealth? The policy for Ontario's citizens to pursue.

A. B.

SECTION. V.

THE MINING SCHOOLS.

Keeping pace with the progress of mining operations in the Province, if not in the lead of such operations, the Mining Schools at Toronto and Kingston are being equipped and strengthened with a view to supplying the scientific and practical instruction upon which success in mining enterprises must always very largely depend. This Section of the report aims at giving an account of what is being done in this direction, not only as to the course of studies and the equipment of the schools, but also as to outside work of Summer Mining Schools and field prospecting with student classes.

THE SCHOOL OF PRACTICAL SCIENCE.

Three-stamp test mill at the School of Practical Science.

For the purpose of making mill tests of about a ton of gold ore at a time, a three-stamp mill with a crusher of the Dodge pattern and a Frue vanner has been added to the School of Practical Science during the past year. Those interested in making thorough tests of any vein or deposit of gold ore will readily see the value of a mill test of this kind. In the first place, by taking quantities of a ton any chance mistake which might arise from relying on assays of small samples is absolutely precluded. Those who are familiar with mining operations can recall instances where considerable sums of money have been spent on the strength of one or more assays of samples picked from the surface. It is very easily possible also, in cases where the gold is coarse and not uniformly distributed, for assays to show nothing even although the ore might pay to work. Another point which is equally important to know is the way in which the gold occurs in the ore, that is, whether as free-milling or in concentrates, as this affects the cost of extraction and consequently the value of the ore. An assay of course only gives the total amount of gold in small sample, and not how it occurs; while panning is open to the objection that only small quantities of a very few pounds at most are taken. Usually it would be impossible to collect a ton of picked samples from any vein without doing a large amount of work. A thorough mill-test is therefore the investor's best safeguard.

Advantage of a mill test.

Arrangement of the mill.

With regard to the arrangement of the mill, as no provision was made for anything of the kind in building the school, the best use had to be made of the available space, and the mill planned to suit existing circumstances. As there was just enough room to allow sufficient fall for the pulp from the stamps over the vanner and down to the drain, the crusher had to be set up on the floor and the crushed ore hoisted by means of a friction pulley to the ore feeder.

Operations in treating the ore.

To follow the ore now in course of being treated, the first operation after any necessary sampling is done by spreading out on the concrete floor and

shovelling so as to mix thoroughly, is to put the ore through the crusher, the jaws of which can be set so as to crush to any desired fineness. This process is only a preliminary step to the fine stamping in the mortar. The crushed ore is then transferred to a bucket, weighed, and hoisted to the ore feeder, which holds about half a ton of ordinary ore. The jar of the stamps keeps the ore feeding slowly into the mortar as long as the stamps are working. The stamps are light, being the kind designed for prospecting, and weigh 225 lb. each. Inside the mortar are two copper plates, silvered on one side to facilitate the amalgamation with mercury; these inside plates catch most of the gold. The pulverized ore is carried through a fine screen by the water fed into the battery, and passed over another amalgamated plate which will take up any gold that may have escaped the inside plates. From this plate the pulp, which should now not contain any free gold, passes on to the distributing board of the vanner and is there spread out over the surface of the rubber belt uniformly. As the belt moves slowly forward and the pulp comes up to the clear water sprinkler, the lighter particles are washed down the belt, and the heavier particles such as iron pyrites, which might contain gold, stick to the belt and pass down underneath through a tank of water, where they are deposited. By this means both the amount and value of concentrates in a ton of ore can be determined. The tailings on the other hand pass down with the water over the tail of the vanner and are left in a tank. The water, after being cleared of anything that would settle, passes off into the drain. When the run is over the tailings can be taken out, dried, sampled carefully and assayed. This will determine the loss of gold.

Motive power.

The machinery is driven by a 6 k. w. constant potential motor supplied by 110 volt incandescent circuit of the city, and was made by the Canadian General Electric Co. at Peterboro'. The crusher, stamps, ore feeder and Frue vanner were supplied by Messrs. Fraser and Chalmers of Chicago.

KINGSTON SCHOOL OF MINING AND AGRICULTURE.

Summer School for teachers.

At the Kingston School of Mining and Agriculture a Summer School for the special benefit of teachers was held during the months of July and August. Seventeen took advantage of the courses in practical chemistry, chemical analysis, mineralogy, crystallography and assaying.

Field prospecting.

In September a field course in prospecting was organized, with the object of making the instruction in prospecting methods thoroughly practical. This was the first course of the kind given in Canada, and the class was limited to twelve. The expedition left Kingston with canoes and camp outfit per Kingston & Pembroke Railway on September 3rd. The canoes were launched in the Mississippi river at Snow Road station, and the party spent the next two weeks examining the mineral resources of the townships of Palmerston, Clarendon and Barrie. Samples of ore from a number of prospects in these townships had been treated at the stamp mill of the school, and it was interesting for the members of the party to see the modes of occurrence of these. A large number of specimens were collected and are now on exhibition at the

school. No systematic geological examination of this district has been made for over twenty years, although promising indications of the occurrence of gold and other metals have been found at a number of localities. The Frontenac county council have expressed the wish that a similar expedition be undertaken this autumn. After being two weeks in this quarter the party spent ten days in the district to the east of the railway, canoeing through Bobb's lake and the Tay river to Perth, thence through the Tay and Rideau canals to Kingston. In this district numerous iron, phosphate, mica and other deposits were examined, and specimens were collected for exhibition in the museum of the school. Some interesting rocks—one of which contains a considerable percentage of nickel—not hitherto reported from this part of Ontario were discovered. The material collected will be utilized to frame a report on the resources of the district. During the expedition each member of the party made a valuable collection of minerals, and gained experience not only in the field geology, but in what is not less valuable for the mineral hunter, rough prospecting methods such as portaging, canoeing and wood-craft. The canoes and camp outfit were supplied by the School. Each member was charged for his share of the incidental expenditure of the party, the total cost per man being $11.98.

Winter session.

On October 1st the third regular session of the School opened. The total number of students enrolled for the first term of the session was 163, showing an increase of 30 over the same time in the previous year.

Stamp Mill.

The mining laboratory or stamp mill has proved of great practical value to the Province. In all, thirteen lots of ore, varying in weight from 200 lb. to 6,000 lb. have been run through, sampled and assayed. In each case the concentrates, tailings and slimes were also sampled and assayed. The following is the list :

		Wt. of ore.
1.	J. H. West, Yarker	600 lb.
2.	E. S. Edmondson, Oshawa (crushed, sampled and assayed only).	200 "
3.	Kaladar ore	6,000 "
4.	Bonanza Gold Mining Co., Wahnapitae	4,000 "
5.	" " "	4,000 "
6.	T. McGown, Parry Sound	2,162 "
7.	H. Roberts, Sharbot Lake	2,003 "
8.	James Stark, Clarendon tp., Frontenac county	2,050 "
9.	T. J. Hempton, Sharbot Lake	1,000 "
10.	Crystal Gold Mining Co., Rathbun, Nipissing	1,990 "
11.	Regina Gold Mine, Lake of the Woods	1,970 "
12.	James McDonald, Mountain Grove, Olden	2,000 "
13.	Damon Youmans, Mountain Grove, Frontenac Co	2,000 "

Results of quartz milled and assayed at the School, published by permission :

No. 2. 200 lb. quartz from the Wahnapitae mine. Gold, 4 dwt. 16 grs. per ton of 2,000 lb., silver, 6 dwt. 10 grs. This ore is worth about $5 a ton.

No. 7. 2,003 lb. quartz from fifth concession, Oso township, Frontenac county, crushed, amalgamated and assayed. The yield of bullion was only trifling, and the ore and concentrates assayed only a small quantity of gold and silver.

No. 9. 1,000 lb. quartz from near Sharbot Lake, crushed, amalgamated and assayed. The yield of bullion was only a few cents. The ore assayed a trace of gold.

No. 10. 1,990 lb. quartz, crushed, amalgamated and assayed. The yield of bullion was 9 oz. 15 dwt. 9 grs., of value $19.50 an ounce. This is equal to a value of $191.44 a ton of

ore. The concentrates assayed in gold $38 a ton, and every 10½ tons of ore yield a ton of concentrates. The assay of the ore showed 10 oz. 8 dwt. 17.76 grs. of gold to the ton, of value $205.73. This shows an extraction by the mill of over 93 per cent. of the assay value.

No. 12. 1,900 lb. of quartz from fourth concession, Olden township, Frontenac county, crushed and amalgamated. The yield of bullion was 4 dwt. 18.16 grains, of value $2.98, equal to $3.14 a ton. The assay of the ore showed a value in gold of $4.64 a ton. The difference between this and the bullion is found in the concentrates and tailings, the assays of which showed rather more than this difference, viz., concentrates, $0.15 per ton of ore, and tailings $2.06 per ton.

While the tests on these ores have, with a few exceptions, led to no positive results, yet the negative verdict has been of value. In most cases small picked samples had been assayed and reported as being rich in gold The mill tests have convinced those concerned that further investment would be at least hazardous.

Thanks to the liberality of the Government and Legislature in providing $1,000 for the work, classes were held between July and December in five important mining centres, as described in the report of Mr. William Hamilton Merritt, which is appended. The Board has received from four of these places requests to urge on the Government the importance of continuing the work and of providing at each place a cabinet of typical minerals for economic and educational purposes. Such cabinets would cost little, and once properly arranged local effort would be largely enlisted in adding to them. The Board commended this proposal to the consideration of the Government, and at the last session of the Legislature provision for the object was made by a grant of money. *Outside classes for prospectors.*

The Government and Legislature in the session of 1895 provided $4,070 for the purpose of equipping the Mining School and Stamp Mill, and the work was carried on during the summer under the personal supervision of the staff. The laboratories are now in excellent condition, and only a small supplementary grant is needed to complete the equipment of the Stamp Mill and the Petrographical Museum. A roasting furnace and chlorination plant is required for tests on refractory gold ores and for treating the concentrates from free milling ores; also an electric motor to run the Frue vanner and chlorination barrel. Experience has shown that the vanner does not do its best work when run rom the same shaft as the rest of the machinery, as it requires uniform speed. *Work in equipping the Mining School and Stamp Mill.*

REPORT ON THE PROSPECTORS' CLASSES.

The following report on the work of the prospectors' classes during the summer of last year was made by Mr. W. H. Merritt to the Board of Governors under date of January 2nd:

"The report which I had the honor to submit to you on the first outside prospectors' class, held at Marmora in the spring of 1894, was very brief, owing to the fact that the class was largely experimental in its character, and the experience derived from a single class was naturally limited. *The pioneer class of 1894.*

"During the present year I have by your instructions held five classes, and I am therefore able to report somewhat more fully on the subject. It may not be unbecoming if I draw your attention to the circumstances which *Circumstances under which the work originated.*

gave rise to this novel branch of instruction, and some reasons why it may be considered of importance to the Province.

"In 1889 the subject of mineral development was brought to the attention of the Ontario Government by the press. A Royal Commission was appointed to enquire into the subject. About this time an article in a mining journal on classes in mining centers in New Zealand attracted my attention, and I brought it to the attention of my colleagues on the Commission. Evidence was then collected from every part of the Province as to the desirability of prospectors' classes, and this evidence, together with extracts made by the secretary from the New Zealand reports, is to be found in the Report of the Royal Commission, which finally strongly recommended that somewhat similar classes should be held in this Province. No action was taken in this matter until you saw the desirability of giving this practical form of educational assistance to our prospectors, and instructed me to hold at Marmora the first class of this character attempted in Canada. The Government of Ontario has since provided the means for carrying on the classes more generally.

The New Zealand course.

"In New Zealand the instruction given at mining centers would from the reports appear more like that undertaken at Kingston in the winter two months' course. It seems that its object was largely to give instruction on the spot to miners and mine foremen with a view to qualify them to pass Government examinations. Nearly every Government exacts that men must hold certificates of competency before they can hold responsible positions in mines.

The objects to be aimed at in Ontario.

"In Ontario we are still in the prospecting stage. Therefore anything that can be done in the direction of assisting the prospector where best to search for, how to recognize, and the simplest field methods of testing minerals of economic value, would appear to be a matter of first-class moment to the Province. Indeed it might well be considered hardly second to the desirability of making the rough road of the prospector as easy as possible, by his being able to hold without expense (other than for development) what he finds, until he can investigate whether it is good, bad or indifferent. We have enormous areas of unprospected lands still in the Province, and the latent value of the largest proportion of them will only be determined by the hardy prospector. There are not many experienced prospectors in Ontario, but with the assistance of prospectors' classes and under the inducement of liberal mining laws their number would undoubtedly increase. As an example of a large body of men whose unquestionable ability and intelligence would render them prospectors of the highest order, I might mention the Ontario Land Surveyors, and suggest that a course such as the two months' winter course at Kingston be substituted for their nominal examination bearing on minerals, etc. Mineral investigation would be immensely assisted by additional knowledge acquired by this able body of men.

Classes at Mine Centre.

"The first prospectors' class commenced on July 15th at Mine Centre, a central point to the mining claims situated in the vicinity of Shoal lake, part of the Seine river system, Rainy River district. No notice had been received

of the intention to hold a class in this vicinity, but, notwithstanding this disadvantage, 44 in all attended the class. At Rat Portage the second class commenced August 12th ; the number that attended the class there was 24 in all. The third class was held at Port Arthur commencing September 4th, and the total number attending the class there was 49 in all. The fourth class was commenced at Sault Ste. Marie on September 23rd, and 24 in all attended this class. The fifth class met at Sudbury on December 6th, regular work commenced on the 9th and concluded on the 23rd December. In all 13 attended this class.

Rat Portage, Port Arthur, Sault Ste. Marie and Sudbury.

"The total number attending these five prospectors' classes was 161 in all. This does not include those who were present at the public lecture which I usually gave before organizing the class, and which I delivered also at Fort Frances where no class was held.

"The attendance was as a rule irregular, and the majority only attended a few lectures between business engagements. In all cases however a certain number faithfully attended the practical work and lectures from start to finish, often spending the whole day at the work of testing samples, etc.

"The work was conducted on the same lines as the Marmora class (mentioned in detail in my last report) with slight modifications, based entirely on practical work, such as would be seen or carried on by the prospector in the field. In connection with these I had about half a ton in weight of specimens and apparatus.

"In the case of prospectors' classes my experience would indicate that it is only after years of experience among mines, miners and prospectors that that information can be acquired which is most desired by the man who has spent much of his life in practical work, perhaps in many fields.

Time for holding classes dependent upon circumstances.

"With reference to the most desirable time for holding prospectors' classes, my experience would lead me to think that for the towns the best time is in the spring before the snow goes off. The early winter does not appear to be much better than the summer, because the prospector is off to find work in the timber camps, the proceeds of which will grub-stake him the next season. In outlying mining camps, such as down on Seine river, fly-time is more apt to lead to a larger congregation of prospectors at the nearest town than at any other time of the year. If ample notice is given, good classes could then be organized at such places. At points where there is no mining excitement it is altogether advisable that a previous visit should be made to the place where the class is to be held, when possible ; or that the matter be taken in hand by one or two gentlemen as a committee. As examples, Port Arthur had a very good, and Rat Portage a fair class after they had been visited, and gentlemen acted as committees ; whereas at Sudbury, where mineral speculation is very quiet just now, no previous visit was made and no committee formed, and there the class was much smaller than at any other place.

"The labor and waste of time packing and unpacking is very great. Some boxes were made for rocks and minerals, and I would recommend that the present ones be strengthened and some others procured if the classes are to be continued.

Permanent collections suggested.

"I submit herewith addresses from the different classes. You will notice that at each central point the class desire to follow up their studies by having a permanent collection of rocks and minerals. The idea is to add to this locally and have a permanent collection which will be available for class work, for reference and comparison, and as an example of the mineral wealth of the district to capitalists who may come with a view to purchase mining property.

"A full list of the persons who attended some or all of the classes has been sent to the bursar. My best thanks are due to many of those gentlemen who attended the classes for assistance cheerfully given.

Local help and encouragement.

"The trustees of the Mining School at Port Arthur could not do enough to further the class, and the town councils of Rat Portage, Port Arthur and Sault Ste. Marie very kindly placed class-rooms at my disposal. In all places visited the proprietors of the local newspapers were extremely kind in doing everything possible to make the classes a success, and our best thanks are due them."

FIELD CLASS IN GEOLOGY AND PROSPECTING.

A class in field geology.

The following very interesting account of the field class of the Kingston School of Mining has been prepared at the request of the Bureau by Prof. W. G. Miller, who had charge of the excursion:

In September, 1895, the school organized a class in field geology and prospecting. The objects of the class were to give that knowledge of geology which cannot be obtained in the class-room or laboratory, to impart a training in rough prospecting methods and to make a somewhat more careful mineralogical and geological examination of the district visited than had previously been made.

On the Missisipi river.

It was decided to limit the party to twelve, and to first visit the district of the upper part of the Mississippi river. Accordingly, on the third of the month the party with a camp outfit and canoes left Kingston by the Kingston and Pembroke Railroad for Snow Road station. Here the canoes were launched and the work begun in the township of Palmerston. As the river here crosses the strike of the rocks, several portages were encountered, and as most of the party had had no experience in portaging and little in canoeing, slow progress was made. Farther up the river, in the townships of Clarendon and Barrie, the channel lies in the direction of the strike, and rapids are fewer. Between the head of Long lake and Mazinaw lake the river again crosses the strike, and the portages again become more numerous. In Palmerston only one metalliferous deposit was visited. This was situated about three-quarters of a mile west of the rapids known as the Ragged Chute.

Magnetite in granite.

It consisted of magnetite in granite, and appeared to be similar to some deposits of the same mineral in the eastern part of Hastings county, which have been described in a late report of the Geological Survey of Canada by Prof. T. D. Adams. This deposit was being opened up at the time of our visit, but the ore "in sight" did not warrant any further outlay of labour. Many of the coarser grained granites of Frontenac and Renfrew counties

contain large grains or lumps of this ore, but not in sufficient quantities to be of economic importance.

As to the geological features along the course of the river in the township mentioned, it may be said that the main part of the river here lies in a trough, the rocks of which are for the most part schists, including crystalline limestones. This trough is bounded on either side by rough, rocky country, the rocks of which are chiefly granitoid gneisses and granite. The rocks in the trough are now considered to belong to the uppermost part of the Laurentian, or to the Huronian. It is chiefly in this trough that the metalliferous minerals of the district have been found. These include galena, zinc blende, stibnite, meneghinite and native gold. The gold occurs in bedded veins, as in Hastings. The other minerals occur in the same form of deposit, and also in cavities in the crystalline limestone.

Geological features along the river.

Minerals, and how they occur.

Small strings of galena have been found in a number of places along the river in this rock, and many pits have been sunk in the vain hope that the deposits, according to the popular theory, would "get wider below." It was found that a great deal of labor and considerable capital had been expended on such deposits. In the eastern part of the district the people have also been deluded through the operations of a "divining rod man," who claims to be able to tell them by means of his instrument whether they have valuable minerals on their properties, the nature of the same, the depth they will have to go to find them, and the extent of the deposits. Several persons have been foolish enough to believe these statements and to expend considerable labor in the fruitless endeavor to find the hidden riches This shows the need of a wider diffusion of a knowledge of the nature of minerals and rocks among people living in the mining districts of the Province, not necessarily that they may find valuable deposits, but to prevent their wasting time and money in places where there is no possibility of valuable minerals occurring.

Delusions of prospectors.

Numerous occurrences of metalliferous minerals were noted along the course of the river, but generally in small quantities. The rocks may be said to be comparatively highly impregnated with metalliferous matter, and there seems no reason why this matter should not have been segregated into lar e veins and that these may not occur in the district.

As stated above, the metalliferous veins are bedded veins, but in the township of Barrie several large quartz veins were examined which are fissure veins, cutting across the strike of the rocks. These however contained no metalliferous minerals, and appear to be of a different age from the bedded veins.

Bedded veins and fissure veins.

In the township of Barrie, along the shores of Long and Marble lakes, a large number of dark basic dikes were observed. Where these cut the crystalline limestone or marble they are among the finest of their kind to be seen anywhere. The dike rock weathers less easily than the enclosing material and stands out prominently from it. In the marble the contrast between the colors of the two rocks is striking, and serves to bring out very distinctly the relations between them. The occurrence of these numerous

Dikes in Barrie township.

dikes shows that the district has been subjected to considerable geological disturbance, and is not an unfavorable indication of the presence of mineral deposits.

Along Marble and Mazinaw lakes.

Above the Marble rapids, at the head of the lake of the same name, along both shores of Mazinaw lake, the rocks are chiefly gneiss and granite and form cliffs of considerable height. In some of the coarser grained granite dikes at the head of Mazinaw lake in Abinger, mica deposits have been opened. The fabulous Myers' cave is said to be situated near the foot of Marble lake, but no one knows out of which one of several caves the discoverer obtained the silver, concerning which so many wondrous tales have been told.

Mica and marble.

The marble of Barrie has long been known to be of good quality, but up to the present little use has been made of it.

Besides collecting specimens of the ores of the district, the members of the party secured a large number of specimens of minerals and rocks, but pressure of work during last winter has prevented any detailed examination of these in the laboratory.

East of the Kingston and Pembroke railroad.

Two weeks were spent in this district, and the following ten days were occupied in a trip to the east of the Kingston and Pembroke railroad. The party started from the head of Bobb's lake in the township of Bedford, thence by the Tay river to Perth, and the Tay and the Rideau canals to Kingston. Along this route the important mineral deposits were visited and specimens collected for future examination in the laboratory. The deposits visited consisted of mica, phosphate and iron. None of them are being worked at present, and all have been described in the reports of the Geological Survey of Canada and elsewhere. Numerous specimens of rocks were collected with the intention of examining them chemically and microscopically for the presence of substances not heretofore found in the district.

Mica, phosphate and iron deposits.

In the townships of Leeds and Storrington a number of basic dikes were observed. A specimen from one of these, which is basalt-like in appearance, gave Mr. R. W. Brock on a preliminary analysis over one-half of one per cent. of nickel, a higher percentage of this metal, it is believed, than has been found in a dike rock from any other part of the world. This rock fuses readily, and there is little difficulty in separating the metal from it. Since rocks of this class contain several per cent. of iron, and nickel may replace the iron in different amounts, it would appear that a chemical examination of all such rocks is desirable.

Nickel in a dike rock.

Cost of the outing, and its practical advantages.

The cost per man per day during the trip was less than fifty cents. It is believed that such classes supply a need in training men in prospecting and exploring methods, and in imparting knowledge to them which cannot be otherwise obtained. Several of the larger scentific institutions in the United States and Europe have summer classes in geology, but these are much more expensive for the student, and in them he does not gain that knowledge of woodcraft and exploring methods which is so necessary to the prospector in new countries.

SECTION VI.

WORK WITH THE DIAMOND DRILL.

What the drill enables the miner and prospector to find out, expeditiously and at relatively small cost.

One of the most important aids to mining yet invented is the diamond drill, which has been widely adopted since its invention by Hermann in 1854, and is now in almost universal use. Its value consists in the opportunity which it gives the miner at a minimum expense of actually seeing and handling a section of the material whose character it is all-important for him to ascertain, yet which is concealed from his gaze by a covering usually of rock, scores, perhaps hundreds of feet in thickness. This the diamond drill enables him to do without sinking shafts or excavating drifts and tunnels which after all might turn out to be so much time and money wasted. It is equally of service in testing new ground and in exploring for bodies of ore in working mines. By its means the prospector may satisfy himself at a comparatively small cost whether the property he is investigating contains ore sufficient in quality and quantity to warrant regular mining operations. If he finds that it does, he knows beyond peradventure where to sink his shafts and how to lay out the work to be done; if it does not, he is saved further trouble and loss. The mining manager is enabled on the one hand to locate masses of ore in advance of actual drifting, and on the other to prove what parts of his territory are dead ground from which no returns can be hoped, and so to conduct his operations in either case intelligently and economically. In almost every large mine diamond drills for exploratory work are part of the regular plant, and are constantly in operation. There can be no guess work as to the strata penetrated by the drill; the cores brought to the surface speak for themselves, and, what is no small advantage, supply samples large enough for detailed examination and analysis. The only point open to question is whether the cores themselves are thoroughly representative of the strata or deposits from which they are taken. As to this, in the matter of gold ore for instance, there is sometimes room for doubt. The drill may pierce a rich pocket in a gold vein and so bring up a core showing a value quite out of proportion to the average contents of the vein, or it may run through a barren stretch and exhibit a core altogether worthless, producing a record in the one case unduly flattering and in the other unjustly condemnatory of the property. Such results however are only to be feared where variable and irregular deposits—as gold veins are occasionally found to be—are being examined by the drill, or where an adequate number of bore-holes has not been made. This drawback is absent where strata possessing regularity and continuity, or large bodies of ore or mineral, such as deposits of iron, copper, nickel, beds of lithographic stone or marble, or similar masses are being examined.

But not an inerrant guide.

The general principles of construction and operation.

There are various makes of diamond drills, but the principles on which they are constructed are substantially the same in all. The boring tool is an annular steel bit set with diamonds, which is attached to the end of a series of

hollow rods, and being rotated under pressure cuts away the rock upon which it bears, the core rising up in the hollow of the rods, or rather in the core barrel which forms their lowest section, and is held when required to be lifted by a split ring in the bottom of the section. As the hole is cut down additional lengths of pipe are screwed on, and when it is desired to bring the core to the surface the rods are raised and the core is taken out. In this way a continuous section of the ground from the time the drill enters solid rock can be obtained, the boring capacity of the machines varying from a few hundred up to two thousand feet. Some of the smaller drills are made to work by hand, but the majority are operated by steam power, or in underground workings by compressed air. For surface work the engine is usually attached to the drill, both being mounted on a wagon for convenience of transport. The boiler for the same reason is also set on wheels. A supply of water is essential to the working of the diamond drill, and a steam pump forms part of the outfit, the duty of which is to send a constant stream through the rods down to the bottom of the hole where the bit is at work and so bring the cuttings to the surface by means of the ascending current, which comes up between the rods and the casing or walls of the hole. It may occasionally happen that in porous or broken rock some fissures or jointing afford the water a subterranean passage, and it is "lost," or ceases coming to the surface. This is far from a desirable state of affairs, and it is necessary for the driller to recover the water. He usually seeks to do so by sending down to the bottom of the hole a supply of cement sufficient when hardened to stop the leak. In some cases bran or similar material is resorted to. Besides bringing the cuttings to the surface, and so keeping the drill runner constantly informed of the nature of the ground being passed through, the "wash" water indicates by its flowing freely or scantily the favorable or unfavorable progress of the work at the bottom of the hole.

The diamonds or carbons, and whence their supply comes.

An important part of a diamond drill outfit, and one which enters largely both into its first cost and the expense of operating it, is the diamonds, or carbons, as they are also called. They are veritable diamonds, procured mainly from Brazil, and are of precisely the same chemical composition as the white and more highly priced gems used for jewelry and ornamental purposes, differing only in color. They are black, or nearly so in shade, occasionally of a reddish tinge, and are found in various sizes. A stone recently got in the old diamond district of Brazil weighs 3,100 carats, and is by far the largest diamond ever known. It is now in the hands of the jewelry firm of Messrs. Kahn & Co. of Paris, and the government of Brazil is negotiating to purchase it for the national museum of that country. Uncertainty as to how so unusually large a stone would turn out has made the dealers somewhat chary of handling it, and the price demanded is considered too great. The probable value was given last year as about $40,000, or 52 shillings 6d. per carat. When stones are found of larger size than can be conveniently used in the diamond drill, they are broken into pieces of about two carats weight, which is the size ordinarily employed. They are of a hardness quite equal to that of the white or colorless variety, and as the abrading action is largely done by the edges and angles of the stones, there is room for considerable skill on the

part of the operator in setting the diamonds so that they may do the greatest amount of work with the minimum of loss. The price of black diamonds fluctuates a good deal according to the conditions of supply and demand, and also to the ability of the combinations which control the black diamond mines to rule the market. In the summer of 1894, when the Department purchased the diamond drill plant, the market price was $17 per carat, and at that time and a little later a supply of diamonds was laid in amounting to 82.605 carats at a cost of $1,356.16, or an average price of $16.40 per carat. In the autumn of 1895 the market advanced to $19 per carat, and again in the following November to $21 per carat. An exceedingly brisk demand set in from the South African gold fields, and in January, 1895, the price rose to $25 per carat, in March to $30, and in April to $36, by far the highest price ever known. Almost the whole production of black diamonds at the present time can find ready sale in South Africa. How prices are regulated

The practice in operating a drill is to keep a sufficient supply of diamonds on hand for at least two bits, so that one may be set while the other is in use. Usually eight stones are set in the bit. Some are placed directly on the face of the bit, some are made to project a fractional part of an inch on the outside of it, and some to project similarly on the inside, the object being to cut an annular ring out of the rock a little greater in width than the bit itself, thus allowing the latter and the rods to which it is attached free play. If for any reason it is desired to enlarge the diameter of the hole after it is put down a "reaming" bit is employed, in which the diamonds are set wholly on the outside. The wear on the diamonds varies greatly according to the hardness and compactness of the rock which is being drilled. In comparatively soft rocks such as limestone, slate or shale, the loss is insignificant, while in such material as quartz, diorite or granite, it is very much greater. In the same way, the rate of boring varies widely. Where the rock is solid and not too hard, a hole may be put down 30 or 40 feet in a day of ten hours, but where greater resistance is met and drilling operations are interfered with by seams and fissures, perhaps the utmost diligence on the part of the drill runner will not suffice to gain more than 3 or 4 feet in the same time. Setting the bit, and wear of the diamonds

Numerous difficulties are likely to present themselves to the operator of a diamond drill plant, and, as his work is so largely hidden from view, only native ingenuity and skill born of experience can enable him to overcome them. The following extract from an excellent article in a recent number of the Engineering Magazine of New York deals with this practical aspect of diamond drill work: Practical aspect of diamond drill work.

"The mishaps that may occur in drilling are many. The most common is the parting of the rods while in a hole. This may come from a fracture of the rods, the stripping of a thread, or the unscrewing of a coupling. The last is more liable to occur when pulling the rods than at any other time, and may result in smashing a set of stones. If rods are simply uncoupled, they can usually be caught by gently lowering and entering the top piece, and turning it to the right. In cases of fractures various sizes of inside and outside recovery taps are provided. The writer once spent two days in recovering a bit in a flat hole where the core shell had twisted off at the core lifter Mishaps that may occur.

ring and left the ring in the lower half of the shell. The recovery tap entered the ring, which was so hard that the tap would not catch it, and yet it would twirl round with the tap, preventing the tap from advancing and catching the inside of the shell. After cutting several portions from the end of the tap, it finally caught the top of the broken shell with one thread and pulled it out.

"When casing or rods are fast in a hole near the bottom, that portion above the obstruction can be removed with a left hand tap. In using left-handed taps the right-handed rods must be pinned at their joints to prevent unscrewing. Fishing for broken rods is much complicated in cases where the ground is soft or caving, and large chambers have been washed out in which the end of the rod may rest and the tap pass by it. It sometimes happens that a diamond is wrenched loose from its setting and remains at the bottom of the hole, either unbroken or in several fragments, when the rods are withdrawn. In cases of this kind the bottom of the hole should be cleaned out by a mass of soap or wax attached to the end of the rods and lowered in the hole. The fragments of rock and carbon will adhere to the sticky material when it is withdrawn. If caving ground catches the rods above the bit they may be released by drilling down a casing outside of the rods and cutting away the bound rod with a steel rose bit.

"Overcoming difficulties at the bottom of a deep hole will tax the ingenuity of a good runner and show his capacity. No man should undertake a deep hole—one over 750 feet—who has not had a good experince with shallow holes."[1]

Keeping a record of borings.

Where the object of drilling is to determine the presence and situation of bodies of ore, it is essential that a record of the borings should be systematically kept. For this purpose the cores as they are brought up should be carefully laid away for reference and examination, which is usually done by placing them in shallow boxes not much exceeding in depth the diameter of the core, a foot or so in width and eight or ten feet long. The various sections of the core should be divided from one another by longitudinal strips of wood, and should be labelled with the number of the hole and depth from which they are taken. The drill manager should also keep a daily record of the work done by the drill, and note all items of interest, causes of delay, etc., from which he should make daily or weekly reports of progress to his employers.

The tendency of drill holes to deflection from a straight line.

A curious fact in connection with diamond drill holes is that they tend to vary from the direction in which they are begun. Vertical holes are liable to take a spiral course, due probably to the fact that there is a natural inclination on the part of the suspended rod to describe an eccentric curve with the free end at the bottom of the hole. Inclined and horizontal holes will also be deflected more or less, according to the nature of the ground and the condition of the boring tools. A case was noted at one of the Cliff shafts in Ishpeming, Mich., where a vertically started hole at a depth of about 400

[1] Prospecting with the Diamond Drill, by J. Parke Channing, in the Engineering Magazine for March, 1896, p. 1085-6.

feet was some fifteen or twenty feet out of plumb. At the Scotchman's United mine, Victoria, a diamond drill hole 370 feet deep was deflected thirty-seven feet three inches. At the Oriental Company's mine a hole 425 feet deep was sixty feet nine inches out of its proper course. Nine holes were drilled in Michigan by Mr. Channing, the writer mentioned above, at angles varying from fifteen to sixty degrees from the horizontal, and the variations at the bottom were from eleven and a half to forty-two degrees. It was invariably found that this variation was in the line of flattening. Captain Peter Pascoe, of the Republic iron mine, reported that in his mine "horizontal holes invariably raised as they gained in length." The rods and core barrel lie on the lower side of the hole, while the bit fills the end. This causes the line of boring at any period to make an angle with the axis of the hole in which the tool is rotating, thus making the line of advance an upward curve.[2] In estimating the results of boring by the diamond drill, this deflection should be taken into account.

Circumstances which influence the cost of work.

The cost of work with the diamond drill depends to a very large extent upon the nature of the rock strata penetrated, being greater in hard and broken, and less in softer and more compact rocks. Distance from means of communication and transport is also an item of importance. It frequently happens that operations are carried on in some remote spot where the roads are bad and where supplies of any kind are hard to get. Under such circumstances the cost is somewhat increased both on account of the difficulty in hauling in the plant, and the necessity for starting a camp for the accommodation of the men engaged on the drill.

The Ontario Government's Drill.

The Ontario Government's drill.

In 1894 the Legislature of Ontario passed an Act relating to Mines and Mining Lands which provided among other things for the purchase by the Government of two diamond drills to be used in the exploratory drilling of ores or minerals in the Province, and in the same session the sum of $15,000 was appropriated to carry out the provisions of the Act. Only one drill has yet been bought, the preference being given after careful investigation to the machine manufactured by the Sullivan Machine Company of Claremont, N. H., and Chicago. A drill of the "C" class made by this company was purchased in August, 1894, at a cost, including certain extra equipment, of $3,611. A 15-horse power boiler mounted on wheels, and a duplex pump, both of Canadian manufacture, together with the customs duty paid on the drill, brought the total cost of the outfit up to $4,275. By the tariff law of Canada diamond drills for mining purposes are admitted free, but the operation of a law depends a good deal upon the interpretation of it. The view was taken by the customs authorities at Toronto that the diamond drill—and consequently the only part of the machine entitled to free admission—was the bit in which the diamonds are set, a circular piece of steel perhaps a half pound in weight. All other portions, including the framework, gearing,

[2] Ibid, pp. 1087-9.

pulleys, etc., were classed as " motive power," and so chargeable with a duty of 15 to 35 per cent. ad valorem, amounting to $350.41 in all. Duty on this basis had to be paid before the drill could be released from bond. On reconsideration of the matter however the Department at Ottawa refunded $230.90 of the amount, leaving the net duty on the machine $119.51. The drill has a capacity to bore 1,200 to 1,500 feet in depth, and takes out a core one and three-sixteenths inches in diameter. It has proven itself a serviceable and satisfactory machine. Certain parts, such as bits, core lifters, etc., are subject to severe wear and tear, and frequently require to be replaced, but as duplicates can be quickly procured from the Company's works at Chicago, where they are kept constantly in stock, no delay or interruption of the work need arise from this cause.

Regulations governing the control and management of the drill.

The regulations governing the control and management of the drill, as approved by His Honor the Lieutenant-Governor in Council, September 15, 1894, and amended by Order in Council, April 9, 1896, provide that it may be supplied to owners of mineral property or others desiring its services upon their furnishing a bond for payment of the costs and charges of working it, including freight, fuel, labor, etc. In order however to encourage the opening up of properties by means of the drill, the Bureau of Mines undertakes to bear 45 per cent. of these charges in 1896 and 1897, leaving the party employing the drill to pay the remainder, or 55 per cent. only. In 1894 and 1895 the proportion payable by the Bureau was 50 per cent., and from 1898 to 1900 inclusive it will be 35 per cent. The Government supplies a mechanical manager of the drill and a fireman, the former being paid at the rate of $1,000 per annum while the drill is at work, and the latter $500. The only additional labor required is the help of a workingman to cut wood, assist in moving the drill, etc. The present manager is Mr. W. W. Roche, an experienced drill operator and miner. Mr. Roche is quite capable of selecting the sites for borings on any location, but the practice hitherto pursued, which is the most satisfactory to both parties, is for the owner of the property to employ an engineer or expert to consult and advise with the manager in the location of the holes, the angle at which they should be bored, etc. It is easily seen that the successful and economic defining of a vein or body of ore depends very largely upon the judicious choice of sites for the borings, the inclination at which they should be made, and the depth to which they should be carried. In deciding upon these points, the skill and experience of the trained miner are most valuable, but they lose nothing of their worth in being reinforced by the conclusions of a competent engineer carefully formed upon the spot. An extra charge of $50 per month is provided for when the services of the drill are retained after the property has been shown by means of the drill to be valuable for its mineral. Provision is made whereby the cores and cuttings from any property shall not be exhibited to any unauthorized person, or information acquired during the working imparted to anyone not entitled to receive the same.

EXPLORING THE GLENDOWER IRON MINE.

Exploration of the Glendower iron mine in Frontenac.

The first property on which the diamond drill was employed was the Glendower iron mine, situated on lots 6 in the second and third concessions of the township of Bedford, in the county of Frontenac, on the shore of Thirty Island lake, and is connected with the Kingston and Pembroke Railway by a spur about four miles in length. It is the property of Mr. Joseph Bawden, barrister, and Messrs. Folger Bros., of Kingston. The ore body, where exposed, has a width of about 20 feet. It occurs in metamorphic rocks which have a strike about northeast and southwest, and dip at an angle of over 80 degrees. The rock on the upper side of the deposit is crystalline limestone, while that on the lower has been described as hornblende schist. The ore itself is a coarse magnetite, and in places is well crystallized and shows a well defined parting. Mixed with the ore there is considerable hornblende in large pieces. The mine was opened in 1873, and about 12,000 tons of good ore were raised and taken to the United States. Operations were then suspended, but were afterwards resumed by another company, and carried on upon an extensive scale for four or five years. It is estimated that about 75,000 tons of ore in all were taken out of the mine.[4] At a depth of about 180 feet considerable sulphur was encountered in the ore, and work was discontinued. Some drilling was done, 300 or 400 feet in all, and it is said that good ore was again obtained. The object of the work undertaken by means of the Government drill was to test the correctness of this statement and to ascertain whether the quality of the ore in the lower portions of the deposit was good enough to warrant the re-opening of the mine. The deposit has been traced on the surface for a distance of 1,134 feet.

Details of the borings.

Work was begun with the drill on 10th November, 1894, at a point about 75 feet south of the old workings, the hole looking to the west and being pitched at an angle of 80 degrees. Crystalline limestone, hornblende, granite and quartz were successively pierced to a depth of 182 feet 6 inches,

3 The Glendower Iron Deposit, by Mr W. G. Miller, B.A., in Journal of Ontario Mining Institue for 1894-5 (p. 61). Mr. Miller discusses the probable origin of this deposit. He says (pp. 62-3): "The magnetite may have been produced through the metamorphism of limonite beds, although the form which the layer of sulphuretted ore takes in the deposit does not seem to point to this mode of origin. The sulphur layer is in a direction transverse to the dip of the deposit, while if the deposit had had a sedimentary origin we would expect this layer to lie in the direction of the dip. . . . From some characters of the hornblende rock on the lower side of the Glendower deposit, it seems possible that the ore may have been derived from this rock by a process of leaching or segregation in solution. The components of the rock in portions of the drill core examined microscopically are essentially pyroxene, which in some of the thin sections examined is seen to be almost completely altered into hornblende, while in others it is quite fresh, and scapolite, with in places a considerable amount of calcite. Large pieces of hornblende are found scattered through the ore, a fact which seems to point to the presence of hornblende in the source from which the iron was derived. The ore, if we accept the view that it has been formed by segregation in solution, was formed in a line of weakness between the limestone on one side and the hornblende rock on the other, and the iron was dissolved out of the latter by water more or less heated percolating through it. Along the line of weakness there would be more chance for the matter carried in solution to become oxidized, and the result would be that the iron which had been dissolved out and put into solution by carbonic acid or other acids or alkalies would be precipitated in the opening and take the place, to a certain extent, of the calcium carbonate which would be dissolved in its stead. This latter material would be carried through by the percolating water and deposited, on the solution becoming concentrated, in the adjoining rocks, where there was little or no oxidation taking place. Thus it is that we find the hornblende rock filled with granules of this secondary calcite. It seems to me, taking all the characters of the ore body into consideration, that the magnetite has originated by this process of segregation from the adjoining rock, although the question needs more careful study than I have been able to give it. This theory will account for the position the sulphuretted band is said to occupy."

4 Michael Grady, in Report of Commission on Mineral Resources of Ontario, p. 136.

when the large drift from the old shaft was struck and the hole abandoned. For the second prospect the drill was removed to a distance of 100 feet west of the old workings, and the hole bored at an angle of 75 degrees pointing to the southeast. The depth reached was 702 feet, but as the angle of dip of the vein nearly coincided with that of the boring, and was in the same direction, the ore body was not struck. The drill was then placed 213 feet south of the main shaft and 100 feet east of the ore formation, the hole being drilled at an angle of 70 degrees pointing to the north. At a distance of 197 feet from the surface the ore formation was struck and drilled through for 83 feet, the hole being finished at a depth of 380 feet. The fourth hole was put down on the same site, the feed screw being lowered and the angle changed to one of 78 degrees. At a depth of 270 feet the ore formation was struck and drilled through for a distance of 125 feet. For No. 5 prospect the drill was kept in the same place, but turned about 10 degrees more to the northwest. The hole was bored at the same angle and in the same general direction as the last, and the ore body was again encountered at a depth of 295 feet. The drillings showed mixed ore from 295 to 340 feet, 25 feet of good ore to 370 feet, and mixed ore from 370 to 430 feet. The hole ended in granite at a depth of 450 feet. The drill was now moved 171 feet south from the site of prospect No. 5 and 100 feet east of the vein. The hole was drilled at an angle of 85 degrees, and limestone was chiefly gone through for a distance of 425 feet, when the ore body was struck. The borings showed the vein to be 30 feet thick at this point. This hole was finished in quartz on 17th June, 1895, at a depth of 525 feet. The aggregate depth of the six borings was 2,626½ feet, and the time consumed was 180 days of actual boring, or at the rate of 14½ feet per day. The rock formations pierced were limestone and granite, with bands of hornblende and quartz. In some places the strata were found to be more or less broken up and obstructive to the drill, but on the whole the ground, especially the limestone, was easily drilled through, and good progress was made, the drill frequently going as much as 30 feet in a day. In hole No. 3, on January 23rd, 24th and 25th, it made 31, 42 and 35 feet respectively. The result of the operations was to show that a very considerable body of good ore existed between masses of mixed ore.

Cost of work at Glendower.

The total cost of the work was $2,591.18, or $0.986 per foot of boring. The various items of expense were as follows :

Services.	Total cost.	Cost per foot.
	$ c.	$
Freight	63 58	0 0242
Lumber, hardware and other supplies	162 24	0.0615
Wood	308 07	0.1173
Teaming and labor	393 72	0.1500
Repairs and renewals	81 95	0.0312
Diamonds	494 34	0.1882
Fireman	354 72	0.1350
Superintendence	732 56	0.2786
Total	2,591 18	0.09860

Of the gross cost 50 per cent. or $1,295.59 was charged to the owners of the property, the remainder being the proportion borne by the Bureau of Mines in accordance with the regulations. The proprietors' share of the expense represented a cost of $0.493 per foot of boring. The total weight of diamonds used was 28.428 carats, worth as stated above, $494.34.

EXPLORING A GOLD PROPERTY.

The Bonanza Nickel Mining Company's gold location, near lake Wahnapitæ.

After work was concluded at the Glendower mine the drill was removed to lot number 2 in the fourth concession of the township of Maclennan, near lake Wahnapitæ, the property of the Bonanza Nickel Mining Oompany. On this location a white quartz vein 60 feet in width, called the 'Mammoth' mine, had been discovered, which though carrying no visible gold had shown by assays a value of as high as $100 per ton. The drill was got to the spot with some difficulty owing to the rough country through which it had to be taken from the railway station, a distance of 15 miles, and was first placed about 70 feet from the foot wall side of the vein, the hole being made at an angle pointing 60 degrees to the south. The conditions were found to be very different from those at Glendower. The hardest kind of granite was encountered for a distance of 138 feet, when the quartz was struck and drilled through a distance of 65 feet, showing the vein to be 32 feet wide at this point, the hole ending in the hanging wall at a total depth of 205 feet. The drill manager reports: "I might here mention that this was a very difficult prospect to bore. The rock, which was the hardest of granite, had to be drilled through with great care on account of the hole being pitched on nearly the same angle and dip as the formation, the bit continually running into hard seams and the cores binding in the core shell. It was even worse when we struck the quartz, as there were so many vugs in the vein, and in these vugs were loose, hard crystals of quartz, which coming in contact with the bit were liable to break the diamonds. Still I managed with great care to drill through and determine the thickness of the vein." The second prospect was located on the line of the vein 350 feet southeast of the first, the drill being placed 38 feet south of the foot wall, and the hole pitched at an angle of 78 degrees pointing to the north. The drilling was begun in quartz and continued in quartz and spar for 29 feet, when the syenite or hanging wall was struck. The water was also lost at this depth, and under instructions from the company's manager the drilling was continued without cementing the crevice through a mixture of syenite, quartz and granite, the prospect being finished in granite at a depth of 91 feet. The frost setting in severely, and the company not wishing to do more work, operations were discontinued.

Cost of the work at the Mammoth mine.

The quartz, granite and syenite penetrated by the drill afforded the most difficult sort of boring. The rate of progress was consequently slow, and the cost per foot between four and five times as high as at the Glendower mine. The loss in weight of diamonds was 23.070 carats, and the cost of this item per foot of boring was upwards of seven times as great as at Glendower,

showing conclusively the obdurate nature of the strata pierced. Following is a statement in detail of the cost of work on this property:

Services.	Total cost.	Cost per foot.
	$ c.	$
Freight	66 70	0.2253
Labor and teaming	109 87	0.3712
Wood	111 82	0.3778
Lumber and drill supplies	43 00	0.1452
Renewals and repairs	118 35	0.4000
Diamonds	403 72	1.3639
Fireman	141 49	0 4780
Superintendence	284 47	0 9610
Total	1,279 42	4.3224

The cost charged to the company was $639.71, or $2.161 per foot, the remainder under the conditions governing the use of the drill being borne by the Bureau of Mines. The drill was at work on this property from 5th August to 23rd October, 1895, 69 working days, boring a depth of 296 feet in all, the average rate of progress per day being 4 feet 3 inches.

AVERAGING THE OPERATIONS.

Aggregates and averages of the drill's record.

Combining the operations of the drill at both places, it is found that a total depth of 2,922½ feet, in eight holes, has been bored by the machine since it was placed in the field, in 249 days' actual work, at an aggregate cost of $3,870.60, or $1.324 per foot. Of this $1,935.30 was charged to the owners of the properties, the average cost to them being thus $0.662 per foot. Following are the items of cost:

Services.	Total cost.	Cost per foot.
	$ c.	$
Freight	130 28	0.0446
Labor and teaming	503 59	0.1723
Wood	419 89	0.1437
Lumber and drill supplies	205 24	0.0701
Renewals and repairs	200 30	0.0685
Diamonds	898 06	0.3072
Fireman	496 21	0 1700
Superintendence	1,017 03	0.3476
Total	3,870 60	1.3240

Comparisons with records elsewhere.

For purposes of comparison, samples from actual experience have been procured, showing the cost of boring with diamond drills under like circumstances elsewhere. It is true that differences in the cost of labor, transportation, fuel, and especially in the hardness of the rocks through which the borings are made, are likely to make such comparisons of doubtful value unless these differences are taken into account. Nevertheless the figures given above for the working of the Government diamond drill will on the whole compare very favorably with those for operations carried on in other countries under conditions as nearly alike as can be obtained. In the New York Engineering and Mining Journal of September 22 and 29, 1894, details are given of the cost per foot of boring nine holes on one of the iron ranges in

Michigan, the aggregate depth being 2,091 feet. The total cost in this case was $2.374 per foot, as compared with $0.986 per foot with the Government drill at Glendower. No particulars are given however as to the character of the rock penetrated on the Michigan property. The items at the latter place are as follows :

Upon iron ore properties in Michigan and

Services.	Cost per foot.
	$
Labor on drill	0.606
Fireman	0.206
Fuel	0 182
Camp account	0 722
Repairs on drill, bits, core barrels, etc	0.126
Repairs on boiler and machinery and sundry supplies	0.097
Carbons	0.239
Superintendence	0.196
Total	2 374

In the article quoted above (pp. 223-4) Mr. Channing gives details of the cost of boring 18 holes to a total depth of 5,046 feet in iron ore properties at various places in Michigan. His figures are summarized as follows :

Services.	Total cost.	Cost per foot.
	$ c.	$
Labor on drills	3,580 27	0 709
Firemen	1,387 24	0 275
Chopping wood	1,266 01	0 251
Camp account	3,208 44	0 636
Bits and repairs on drills	585 47	0.116
Supplies and repairs on machinery	440 51	0 088
Carbons	1,660 97	0 330
Superintendence	1,006 38	0.199
Total	13,135 29	2 604

The material encountered in the holes consisted of iron slates, diorites jasper, quartzite, etc.

In the same article the expense of operations conducted by Mr E. J. Longyear of Hibbing, Minn., comprising twenty-one holes and an aggregate depth of 4,684 feet is given. The figures are as follows : Minnesota.

Services.	Total cost.	Cost per foot.
Labor	$5,569 74	$1.189
Fuel at boiler	735 97	.157
Camp account	2,416 49	.516
Bits and repairs on drills	722 24	.154
Supplies, boiler and pump repairs	226 28	.048
Carbons	3,201 09	.684
Superintendence	1,211 51	.259
Total	$14,083 32	$3.007

The strata passed through consisted of jasper, iron slates, sandstone, and marble.

In the East New York mine at Ishpeming, Mich., twenty-eight holes were bored to a depth of 3,746 feet, of which 193 feet were in hematite, 646 feet in jasper, 986 feet in mixed ore and 1,921 in dioritic schist. The record of cost as given by Mr. Channing is as follows:

Cost of underground drillings.

Services.		Total cost.	Cost per foot.
400¼ days' setter at $3 00	$1,200 75		
372 " runner at 2 25	837 00		
230¼ " " 2 00	460 50		
4½ " laborer at 1 75	7 85		
		$2,506 10	$0.669
Carbons, 68⅜ carats at $15.144		1,035 47	.276
Bits, lifters, shells, barrels and repairs		433 81	.115
Oil, candles, waste and supplies		128 09	.035
Estimated cost compressed air		374 60	.100
Total		$4,478 07	$1.195

Two instances of underground drilling are given in the same article, in both of which the cost was much less than in the operations conducted from the surface. The first is from the records of the Minnesota Iron Company, and covers a period of twenty months from May 1, 1894, to December 31, 1895.

Services.	Total cost.	Cost per foot.
No. of feet drilled, 13,512		
Carbons	$4,587 82	$0.340
Supplies and oils	939 84	0.070
Fuel	547 39	0.040
Shop labor and material	679 01	0.050
Pay roll	3,694 83	0.273
Total	10,448 89	$0.773

This drilling was all done in the back stopes, almost every foot being in the ore. The drills used were the Sullivan make, "E" size, the holes being one and a half inches in diameter and from ten to forty feet deep, the machines being operated by compressed air.

The second instance is from work done at the Cleveland mine, Ishpeming, Mich., in 1892. It consisted of 6,075 feet of underground drilling and 1,414 feet of surface drilling with 470 feet of standpipe sunk.

Services.	Total cost.	Cost per foot.
Carbon	$1,887 00	$0.237
Supplies and oils	134 13	.017
Fuel	360 73	.045
Shop material, etc	663 36	.083
Pay roll	4,000 03	.502
Total	$7,045 25	$0.884[5]

[5]The Engineering Magazine, March, 1896, pp. 1091-2.

The last two tables are given in order to show the cost of exploring for ore bodies in working mines, but they are not strictly comparable with the cost of work done by the Government drill, or with surface operations generally, as the latter embraces items of expense, such as freight and teaming, which are absent in the former case.

BORINGS IN AUSTRALIA.

The Government of New South Wales, Australia, employs diamond drills for exploring purposes, the cost apparently being divided between the Government and the property owner. In 1894 the total depth bored was 557 feet, and the cost for boring, exclusive of reaming, was £468 2s., or 16s. 9½d. per foot, equal to $4.07 of our money. This cost seems large, and may be partly accounted for by the small extent of boring. In 1893 the depth drilled was 1,903 feet 7 inches, at a cost of 12s. 4⅞d. per foot, equal to $3.01 per foot. The rate of boring in 1894 was 12.55 inches per hour, and the diameter of the bore was four inches, much larger than that of the Ontario drill. The expenditure for diamonds was 9d. per foot—almost exactly the same as at the Glendower mine—and the work appears to have been done in basalt interbedded in clay. In 1893 the cost for diamonds was 3s. 3⅜d. per foot, more than four times as great as in 1894. The reason for this difference is not explained. Government drills in New South Wales.

In the colony of Victoria extensive borings have also been carried on by the Department of Mines for several years in search of auriferous deposits and in prospecting for coal. The aggregate depth bored for gold in 1894 was 28,347 feet 9 inches, and the total cost £10,663 12s. 9d. Of this distance 21,148 feet 11 inches was put down by means of diamond drills at a cost of £9,673 17s. 6d., or 14s. 3¼d. per foot, equal to $3.47 per foot. Other boring machines on contract drilled 7,198 feet 10 inches at an expense to the Department of £989 15s., or 3s. 6¾d. per foot, to which apparently a like amount is to be added for the share of the cost borne by the private individual or company. In prospecting for coal two types of drill were employed, the diamond drill and the calyx machine. The last mentioned is said to be an entirely new invention, working with steel cutters instead of diamonds, at an expense much less than that of the diamond drill. The cost of operating the latter in the coal measures was 11s. 6d. per foot, while for the calyx machine it was 6s. 0½d., a marked difference in favor of the new machine. The following reference to the work of the calyx drill is made in the report of the Superintendent of Drills for 1894: In Victoria. The calyx drill, working with steel cutters instead of diamonds.

"In the trial bore the calyx drill demonstrated its capabilities in a decisive manner. The drill as a whole was certainly not much to look at, but its performances were somewhat astonishing. It cut a 5½ inch bore to 700 feet, and produced a perfect core by manual labor and horse gear at less than half the cost of average diamond drill work in similar strata" The Superintendent adds that he considers it "possible to evolve from the primary principle of this system the most economical and generally useful boring machine that could be devised." No account is given of the construction of the calyx drill, and no opinion can therefore be formed as to the likelihood of its usefulness

in piercing the dense strata which in part compose the Huronian system of Ontario. Its use in Victoria seems to have been so far confined to the softer rocks of the coal measures.

Victoria adopts the same system of apportioning cost as Ontario.

In his report for 1894 the Secretary of Mines for Victoria remarks upon a change of principle which was introduced during the year as regards the employment of Government diamond drills. On several grounds, among which that of economy was prominent, it was decided that future borings, whether for gold or coal, should unless in cases of purely national character recommended by the departmental officers, be done only when the persons requiring it paid one-half the expense. "This change," the Secretary states, "has been productive of much good. The work done by the drills has been restricted to cases where some tangible result might be foreseen, and cases have almost ceased where applications for diamond drill service were made, and pressed apparently in view of the local expenditure of the drill expenses." It will be observed that the system in use in Ontario, so far as the sharing of the expense between the Government and the party obtaining the services of the drill is concerned, is practically the same as that now in vogue in Victoria after trial of a plan there by which the work was done entirely at the cost of the public chest.

Scope of exploration work for a drill in Ontario.

In view of the undeveloped mineral wealth of this Province and of the liberal terms upon which the use of the drill is offered to miners and owners of mineral properties, it would seem that there should be plenty of room for its employment in Ontario. Should an improvement take place in the nickel mining industry, either by the springing up of an increased demand for the metal, or the introduction of new methods in the treatment of the ore, such as the substitution of pyritic roasting and reduction for the expensive roast-heap and coke smelting processes, there would be a large field of usefulness for it in proving some of the many unexplored and dormant copper-nickel deposits of the Sudbury region. The demand for both magnetic and hematite ore to supply the new blast furnace at Hamilton should, and doubtless will, induce owners of iron properties conveniently situated to examine them with the view of transforming them into producing mines. In the Lake of the Woods, Rainy lake and contiguous regions are many gold locations of promise, some of which are at the present time being explored by drills in the hands of private parties. If the holders of others were equally desirous of ascertaining the quality and extent of the quartz veins on their lands, the assistance afforded by the Government would very materially lessen the cost to them of acquiring this information. We can hardly hope to find in our ancient Huronian rocks, denuded by glacial action as they have been, beds of auriferous gravel, such as are encountered under ground in Australia and California, however deep or assiduously we may bore for them, but in exploring for copper, nickel, iron, gold, or stone of any kind, the use of the Government drill might well be extended with advantage to the holders of mining lands and to the Province at large. T. W. G.

SECTION VII.

MINING ACCIDENTS.

The year 1895 was marked by a noticeable decrease in the number of fatal accidents as compared with the two previous years. In 1893 three, and in 1894 seven lives were lost in casualties of various kinds, while last year only two miners paid the last penalty to the hazardous nature of their calling. Both of these occurrences took place in the Lake of the Woods gold region, the Sudbury mining district being entirely free from loss of life. Apart from these two cases, the mishaps of the year were relatively light in character, affecting in most instances individuals only, and causing injuries, painful no doubt, but happily not serious or permanent. Comparative casualties.

The table on page 236 sets forth in detail the particulars of the accidents, both fatal and non-fatal.

For the second consecutive year explosion of dynamite in hot ore is lacking as a cause of accident, the two casualties due to the unexpected discharge of explosives on roast heaps occurring in cold ore. This is sufficient proof of the propriety of the legislative provision made in 1894, prohibiting the use of dualin or explosives of any kind for the breaking up of roasted ore while in a heated condition. This dangerous practice in one or two previous years was the cause of several fatal accidents. The causes of accidents. Premature explosion.

Falls of rock and ore, too, usually a prolific source of trouble, do not occupy a place among the causes of disaster in 1895. Falls of rock and ore.

The most notable accident of the year, an account of which is given below, was that at the Sultana gold mine, where the burning of the shaft house imprisoned nine miners for about five hours, and resulted in the complete asphyxia of one of the men and the partial asphyxia of the others. Had the second shaft in process of construction at the time been completed, it is possible the men might have made their way to the surface even when their escape by the other was entirely cut off by the blazing building and timbers at the top. No complaint has ever been made, so far as the Bureau is aware, as to the ventilation of the mine or the sufficiency of the means of ingress and egress, and while there may be room for difference of opinion as to the advisability of housing all the machinery under one roof, and that the roof of the shaft house, and also as to the sufficiency of the means of signalling from the top to the bottom of the mine, the novel and unexpected nature of the occurrence was such as to render it difficult to foresee and take precautions against. Fire.

Particulars of fatal and non-fatal accidents at mines during the year.

No.	Date.	Owner of mine.	Name of mine.	Name of injured person.	Nature of injuries.	Cause of accident.
1	March 11	John F. Caldwell	Sultana	John Lagier	Killed	Burning of shaft house, and consequent imprisonment in mine.
				Charles Ankstrom	Partial suffocation; recovered.	
				Rudolph Erickson	do do	
				William Prym	do do	
				Charles Yen	do do	
				John Ankstrom	do do	
				Peter Straw	do do	
				Emic Petersen	do do	
				Alex. Neilson	do do	
2	Aug. 7	Canadian Copper Coy	Copper Cliff	James Dubroy	Burned on back and arms	Explosion of molten slag.
				Charles Reinens	do do	
3	" 13	do	do	Orson Crank	Compound fracture of ankle bones	Fall of piece of rock from skip.
4	" 15	do	do	Paul Rioux	Slightly injured	Premature explosion.
5	Nov. 5	do	do	Aug. St. Ammond	Loss of eyesight	do
6	" —	—— Brearton	——	—— Brearton	Killed	do
				—— McCarthy	Severely injured	do

The second fatality also took place in the neighborhood of Rat Portage, in a small prospecting pit being sunk by two miners named Brearton and McCarthy, by which the former lost his life through the premature explosion of a charge of dynamite. Owing to this accident not having occurred in a mine employing at least six men under ground, the provisions of the law did not require it to be reported to the Bureau, and it was not so reported. As however it was clearly a mining accident, inquiry was made into the circumstances connected with it, which are briefly detailed below.

Explosion in a prospecting pit.

The first accident of the year, and the one involving the largest number of men, though fortunately all but a single individual escaped with their lives and without permanent injury, was that referred to above at the Sultana gold mine, Rat Portage. About 9.30 a.m., on Monday, March 11th, the shaft house at the mine, containing air-compressor, hoisting and other machinery, was seen to be on fire, having been ignited it is thought by a spark from the smokestack. Pump and hose were at once set to work upon the flames, but after about ten minutes playing the roof fell in and broke the pipe, disabling the pump. The use of buckets was then resorted to, but without much success, and the fire continued to burn until the building was consumed. At the time of the occurrence there were nine men, mostly Swedes and Finns, at work below ground. Foreman Johnson signalled to them to come up by pulling on the bell wire as soon as the fire broke out, but as the bell was at the top and not at the bottom of the shaft, they did not understand the message, and before they could appreciate the gravity of their situation, or indeed realize that they were in danger at all, the framework at the mouth of the shaft was in flames and all means of egress were cut off. The foreman stated that from the time the fire broke out a period of about ten minutes elapsed, during which the men might have come out from the shaft, but that afterwards escape was impossible until the building was burned down. Anderson, the engine-tender, placed such period at three or four minutes. One of the miners, Charles Ankstrom, having filled an ore bucket and rung the bell, went up to see why it was not hoisted, but found the shaft on fire. He tried to force his way through the blazing timbers, but though he got as far as the shaft house floor, he was unable to do so. He immediately descended the ladders and informed his fellow-workmen, who went up in a body, but were likewise driven back by the fire. Nothing was then left to the entombed miners but to await the result with what composure they could. Their situation was indeed precarious. Smoke from the burning structure above, mingled with the water thrown on the flames, found its way in large volume down the shaft, and as the supply of fresh air was cut off by the stoppage of the air compressor and the proportion of oxygen lessened by the fire at the mouth of the shaft, there was imminent danger of the imprisoned workmen perishing by suffocation. Great anxiety was felt on their behalf by their companions at the surface and by those responsible for the management of the mine, but nothing could be done for their relief until the fire at the shaft house had subsided. This took place about 2 p m., and a rescuing party was organized to descend the mine and ascertain the fate of the shut in miners.

Fatal accident at the Sultana gold mine.

The first man to go down was Axel Carlson, a brave Swede and one of the drill-runners at the mine, who was lowered by rope and tackle, the ladders having been burned. Albert Johnson, foreman of the mine, and Gust Blonquist, a miner, followed, then Mr. J. R. Bell, the assayer, and Mr. W. G. Motley, M.E. They found the men, one on the first level, five in the timbers above it, and three at the bottom of the mine. They were nearly all insensible, and all in various stages of suffocation. One by one they were carefully secured and sent to the surface; but when the rescuers reached John Lagier (or Lazier), who was the third man encountered, they found him at the last gasp. As Mr. Motley put his arms about the unfortunate miner to adjust the rope round his chest, he heaved a long sigh and never again showed symptoms of life. Dr. Macdonell, of Rat Portage, who was doing everything possible for the men as they were brought up, worked for some time endeavoring to revive the deceased, but his efforts were in vain. All the rescued men were suffering more or less from asphyxia, and two or three from exposure to the water which poured down the shaft in the attempt to extinguish the fire. In a short time however they recovered their usual state of health. It appeared from evidence taken at the inquest subsequently that Lagier had been at work at the mine only some three or four days, and that he was troubled with heart disease, or some other complaint which produced a chronic shortness of breath. It had been remarked on several occasions that after ascending the ladderway, on coming out of the mine, he seemed distressed and was obliged to sit down and rest.

Rescue of the imprisoned miners.

At the request of Stipendiary Magistrate James Robinson, an inquest was held on the body of Lagier by Coroner Frank J. Ap'John. A jury of twelve citizens of Rat Portage was summoned, Mr. Frank Gardner being foreman. Considerable evidence was given by those present at the occurrence, including several of the imprisoned miners and members of the rescuing party. Mr. John F. Caldwell, owner of the mine, gave testimony as to its general condition, and the manner in which the requirements of the Mines Act were complied with. Dr. Macdonell stated it as his opinion that Lagier did not die of asphyxia, but that he had been suffering from heart trouble or spasmodic asthma, and that the excitement induced by the situation in which he found himself might have caused his death, or it might have been due to fatty degeneration of the heart. The jury returned the following verdict:

Coroner's inquest, and the

"We find that the said John Lagier came to his death from excitement and prostration caused from the burning of the shaft house over the Sultana mine. We find from the evidence that the owner of the mine, at which place the accident happened, has complied with the regulations demanded by The Mines Act of the Province of Ontario, and that no blame for the death of said John Lagier can be ataached to the owner of the mine."

Jury's verdict.

Deceased was 30 or 35 years of age, unmarried, and a recent immigrant from Grenoble, France. He was not an experienced miner.

The mine employés when questioned on the subject at the inquest testified that in their opinion the arrangements for ventilating the mine, the ladders, signals, etc., were quite sufficient and equal to those generally in

use in other mines. Mr. Motley, then manager of the Regina Gold Mining Company, stated in his evidence that he had been down the Sultana mine shaft and all through the mine several times, and that he considered it in every way a safe place for men to work in. The ladderways were in perfect order and the air was good. As to signalling, he said: "At the other mines it is customary to have a regular code of signals between the top and the bottom of the mine. Had there been an alarm given from the surface which the men understood, they would have come out, in case they had time. It would take about five minutes to descend the ladder 150 feet and return were one in a hurry."

Under date of August 7th the Canadian Copper Company reported that at 3 p.m. of that day an explosion of molten slag had occurred at their smelter whereby two of their workmen, James Dubroy and Charles Reinens, were burned about the back and arms. The burns were small, but numerous. The explosion took place in the settling pot at front of No. 1 furnace Its cause was not quite clear, but it was probably due to the unexpected starting of a rivet head in the settling pot, thus allowing a sudden leakage of water to occur. The men recovered from the accident without having received any permanent injuries. Accidents at the Canadian Copper Co's smelter,

On 13th August, at the Copper Cliff mine of the same company, one of the workmen named Orson Crank received a compound fracture of the ankle bones of the left leg. The ore was being dumped from the skip to the rock house floor as usual, but a piece rolled on Crank's ankle before he got out of the way. The injury was severe enough to require amputation of the foot, but otherwise the Company reported on 22nd August that he "was doing very nicely." mine,

At 2 p.m. on August 15th a premature explosion took place on a roasted ore heap at the Copper Cliff mine, by which one Paul Rioux received somewhat severe injuries on the face, eyes, neck and hands. Rioux was in the employ of Messrs. Trist & McKinnon, contractors for roasting the ore, and was the workman whose special duty it was to do the blasting in the ore heaps, having been employed at this work for a long time. The man's own statement as to the occurrence was as follows: and roast heaps.

"I lighted the fuse before placing the cartridge in the hole. I then found that the hole was too small, and I tried to push the cartridge in. The fuse burned down quicker than I expected it would, and the cartridge exploded before I got away." Rioux was taken to the hospital at Sudbury, and although it was at first feared that he would lose the sight of one of his eyes, he made a favorable recovery.

On 5th November Aug. St. Ammond, also in the employ of Messrs. Trist & McKinnon as blaster at the Copper Cliff roast yard, while engaged in blasting in cold ore on roast bed No. 266 was badly hurt by a prematurely discharged shot, being especially injured in the eyes. No one witnessed the occurrence, but St. Ammond's own account of it was that he had lit the fuse, putting the cartridge in the hole, and did not think he had cut the fuse long enough. Everything possible was done to alleviate the injured man's suffer-

ings and improve his condition. He eventually regained his health, but not his eyesight, and is now totally blind.

Amending the Regulations in consequence of a fatal accident near Rat Portage.

The Mines Act 1892 declared that no mine should be subject to Part IV. of the Act, which provided among other things for the reporting of accidents to the Bureau of Mines, unless more than six persons were employed under ground. Owing to this provision it is possible that some accidents which were strictly mining in their character may have occurred without being brought to the notice of the Bureau. A case of this sort was reported in the Toronto papers by which one Brearton lost his life and one McCarthy was seriously injured through a premature explosion of dynamite in a mining prospect just east of the town of Rat Portage in November last. No notice of this casualty was sent to the Bureau, but on inquiry being made it was found that the two men were working in a pit on the property which was only a few feet deep. The stick of dynamite had been put into the drill-hole, and had either been dropped with some violence to the bottom or was being tamped home when the explosion occurred. Brearton received the full force of the shot under the chin, and was driven back against the wall of the pit and instantly killed. McCarthy, who was standing close by, was knocked over and had his arm badly damaged by the fall, or by the rock striking him. He was taken to Winnipeg, where it was at first believed he would have to submit to the amputation of his arm ; but in time he fortunately recovered without sustaining the loss of it. It is stated that Brearton was careless in handling explosives, and that McCarthy knew nothing about them, not being accustomed to mining. The coroner was notified of Brearton's death, but no request was made to him to hold an inquest and he did not consider one called for. The occurrence was plainly accidental, and if blame was due to any one it was doubtless to the unfortunate man who paid the penalty for his carelessness—if careless he were—with his life.

All accidents to be reported to the Bureau.

Section 53 of The Mines Act 1892 was repealed by An Act to make further provision respecting Mines and Mining, passed during the session of 1896, and all mines, pits and other openings from which any ores or minerals are taken are made subject to the provisions of Part IV. of The Mines Act, and all accidents happening in them are required to be reported to the Bureau, regardless of the number of employés.

T. W. G.

Mr. BORRON'S REPORT

ON A SECTION OF THE HEIGHT OF LAND REGION NORTHEAST OF LAKE SUPERIOR.

To Archibald Blue, Director of the Bureau of Mines:

Sir,—In accordance with instructions received through you from the honorable the Commissioner of Crown Lands I have examined, with special reference to its mineral resources, that part of the provincial territory contiguous to the Canadian Pacific Railway between Trudeau station in the vicinity of White lake and Missinaibi station, and have the honor to submit the following brief report. Region of country examined,

The object aimed at by this examination was, as understood by the writer, intended to be of a practical rather than a scientific character; not a minute and exhaustive exploration of a small tract, such as is required from the prospector, but a general and somewhat hasty examination of an extensive territory. and the object aimed at.

Before proceeding to lay before you the conclusions arrived at, it may be well to give a short narrative of the course pursued.

For various reasons the writer concluded it would be better to proceed to White lake via Sault Ste. Marie and Michipicoten than to take rail direct to that point. Among others was the uncertainty of being able to procure the requisite outfit and suitable men if the all rail route were adopted. Outfit for the work.

At Sault Ste. Marie, to which the writer proceeded by way of Owen Sound, he was joined by John Driver, whose services had been previously secured. A suitable canoe and a few needful mining tools and supplies were also obtained at that point. From thence Michipicoten was reached by the steamer Telegram. At the Hudson's Bay Company's post there it was confidently expected that there would be no difficulty in procuring Indian voyageurs and guides thoroughly acquainted with the territory it was proposed to examine. In this we were not so fortunate as previous experience had led us to anticipate. Since the completion of the Canadian Pacific Railway the Indians whose hunting grounds are on the height of land, and who used to resort to Michipicoten to trade their furs and obtain supplies, have for the most part ceased to do so, finding it more convenient to do their trading at the inland posts of the Company. There were in consequence very few Indians at the post, and these mostly employed in fishing for one or the other of the parties engaged in the pursuit of that industry. This occasioned some delay, and necessitated the employment of men who although good voyageurs were not as intimately acquainted with the country as was desirable. Supplies and men.

OUTLINE OF THE ROUTES TAKEN.

Having on previous occasions followed the usually travelled canoe route between Michipicoten and Missinaibi station, the writer concluded to take another and rarely followed route up the Magpie, a large tributary which

joins Michipicoten river about a mile above the post. This route is a difficult and tedious one for other than small and light canoes. Our guides too were not as familiar with it as we had been lead to expect. They were several times unable to find the portages, thereby occasioning considerable delay. Our progress was rendered still slower by the serious indisposition of John Driver, and his inability to afford needful assistance on the portages and in ascending the rapids and strong currents met with on this route. It took in consequence nearly a week to reach the point where the Magpie is crossed by the Canadian Pacific Railway. This point is five miles east of Grassett station, and about a mile only below Esnagami or Shell lake, the source of the Magpie.

The region of country traversed by canoe and rail.

As there was a possibility of the writer being required in connection with the Indian branch of the claims of the Dominion against the Province, then as now under arbitration, arrangements had been made before leaving Toronto that if wanted he would be notified to that effect by letter addressed to White River. It was thought better therefore to get such letter, if sent, before proceeding further west, and the postmaster was telegraphed to forward any letters lying at that office to Grassett.

In the meantime arrangements were made for the exploration of Esnagami or Shell lake, where it was expected that an Indian named Paul, thoroughly acquainted with the country from thence to White river, would be found. Hopes were entertained that he might be able to accompany us as guide, or at all events afford us reliable information in reference to the territory, and more particularly the canoe route, if any such were practicable, from lake Esnagami to White River station. The search for Paul was not rewarded with success, and having completed our exploration of the lake, the extreme length of which is about 20 miles, we took rail from Grassett to White River station, a distance by the line of 36 miles.

White river

From this point to White lake the White river is fairly navigable by canoe, and the trip about 28 miles from White River station to Montizambert, some two miles distant from Indian station, was completed in two and a-half days. In this stretch, which is much longer by water than by rail, about half a dozen portages, several of considerable length, had to be made.

On his arrival at Montizambert, where the Hudson's Bay Company have a post, the writer had the pleasure of meeting with several old friends, officers and servants of the Company, whose acquaintance he had made on previous expeditions to James bay. One had been last seen at Rupert's House, another at Albany Factory, the third at Mamattawa, the junction of the Kenogami (Long lake) and Oba rivers, and the fourth at Brunswick Post, formerly Missinaibi, by all of whom he was cordially welcomed.

After examining White lake, White river was re-ascended as far as Bremner station, where to avoid the rapids and portages above that point, which would have occasioned considerable delay, the cars were taken to White River station, sixteen miles distant by the line. Several small lakes on the south side of the railway in the vicinity of this station were then visited and the rocks examined. This done, having seen sufficient of the general character of the country to enable him to form an opinion as to the probability or

otherwise of the existence of economic minerals in paying quantity, the writer returned with his party by rail to Missinaibi station.

At Missinaibi the two men hired at Michipicoten left for home, and some little difficulty and delay were experienced in obtaining others to replace them. Substitutes however were procured from Brunswick Post, at the northern end of lake Missinaibi, about forty miles distant.

The next point visited, but somewhat hurriedly examined, was a large lake called Wabatonguishene. It is situated a few miles northwest of the western extremity of Matagama, or Dog lake, and is the source of the Michipicoten river. During the exploration of this lake the writer contracted a severe cold, which compelled him to return to Missinaibi sooner than he otherwise would have done.

Planning a trip to lake Opazatika.

Disappointed with the character of the country in the immediate vicinity of the railway, the writer now determined, if able, to go as far as lake Opazatika, with the view of testing an apparently large deposit of iron pyrites, discovered by him in the year 1886 near the river Opazatika, but which for want of the necessary tools he was at that time unable to examine as fully as he desired.

Arrangements having been completed, a start was made, and on the second day Brunswick Post was reached. Here he was informed by the officer in charge that the portages, numbering about twenty, over which it would be necessary to pass both going and returning, were for the most part in a bad state, and as some threatening symptoms in connection with his cold had developed themselves, he was reluctantly compelled to abandon his intention of going further himself.

John Driver however, who had had considerable experience as an explorer, was sent forward to make the examination that was wanted. With instructions and a map showing where the deposit was situated, no doubt was felt as to his finding it. The writer himself returned to Missinaibi, and a few days later to Toronto.

Subsequently he went to Sault Ste. Marie to meet Driver, when he got back from the Opazatika country. He had been instructed to return via Michipicoten.

The result of Driver's exploration will be found in his report to me, given as nearly in his own words as possible. If he be not too sanguine the results are, to say the least, satisfactory. The iron pyrites vein discovered by him at the Split Rock portage is especially worthy of further examination.

THE GEOLOGICAL FORMATION, OR COUNTRY ROCK.

The Laurentian and Huronian systems of rocks.

The character of the country rock is one of the first points upon which every miner and prospector desires to obtain reliable information. On the great plateau which constitutes the height of land and divides the waters flowing northward into Hudson bay from those flowing into lake Huron, lake Superior and the St. Lawrence river, two groups or series of rocks only are met with. These are known to our geologists as the Laurentian and the

Huronian. Both are included in recent classifications under the general term Azoic, or Archæan, signifying destitute of life, or non-fossiliferous.

Sir William Logan on the Laurentian.

Of the Laurentian formation the late Sir William Logan, Director of the Geological Survey of Canada and the author of the terms, speaking of the rocks included in this series, says: "They are the most ancient yet known on the continent of America, and are supposed to be equivalent to the iron-bearing series of Scandinavia. Stretching on the north side of the St. Lawrence from Labrador to lake Superior, they occupy by far the larger share of Canada, and they have been described in former reports as sedimentary deposits in an altered condition, consisting of gneiss interstratified with important bands of crystalline limestone. . . . It is also in contact with these limestones, or near them, that the iron ores are found which so prominently characterize the Laurentian series, as well as the lead bearing veins belonging to it; and as the limestones possess external and internal characters, which render them more conspicuously distinct from the gneiss than any of the component members of the gneiss are from one another, they afford the least difficult means of tracing out the physical structure of the Laurentide district. The distribution of the limestones therefore becomes a subject both scientifically and economically important, but it is one the investigation of which will require a great amount of patient labor. To determine the superposition of the component parts of such an ancient series of rocks as the Laurentian is a task which has never yet been accomplished in geology, and the difficulties attending it arise from the absence of fossils to characterize its different members"[1]

Again, on pp. 49-50, it is stated: "In the reports of the Survey the Laurentian rocks have been described in general terms as gneiss, interstratified with important masses of crystalline limestone. The term gneiss, strictly defined, signifies a granite with its elements, quartz, feldspar and mica, arranged in parallel planes and containing a larger amount of mica than ordinary granite possesses, giving to the rock a schistose or lamellar structure. When hornblende instead of mica is associated with quartz and feldspar, the rock is termed syenite, but as there is no specific single name for a rock containing these elements in a lamellar arrangement, it receives the appellation of syenitic gneiss. Gneiss rock then becomes divided into two kinds, granitic and syenitic gneiss, and the word gneiss would thus appear rather to indicate the lamellar arrangement than the mineral composition. Granitic and syenitic gneiss were the terms applied to these rocks in the first reports, but as granite and syenite are considered rocks of igneous origin, and the epithets derived from them might be supposed to have a theoretical reference to such an origin of the gneiss, while at the same time it appears to me that the Laurentian series are altered sedimentary rocks, the epithets micaceous and hornblendic have been given to the gneiss in later reports as the best mode of designating the facts of mineral composition and lamellar arrangement, without any reference whatever to the supposed origin of the rocks. When the general term gneiss therefore is used it may signify both kinds, or either;

[1] Report of Progress of the Geological Survey of Canada for 1853-54-55 and-56. pp. 7, 8.

and the epithets micaceous and hornblendic are applied to the rock to indicate that the mica greatly preponderates, or excludes the hornblende, or the hornblende the mica."

Later, the officers of the Geological Survey seem to have divided the rocks embraced in this Laurentian system into two formations, known respectively as the Upper and the Lower Laurentian formations.

Dr. Bell, assistant Director of the Survey—who (as the writer believes) has examined a greater extent of territory covered by Laurentian rocks than any other geologist in Canada, and who has devoted nearly thirty years to the study principally of the Huronian and Laurentian systems--has given us in his memoir entitled "The Geology of Ontario, with special reference to Economic Minerals," in a popular form the conclusions at which after so much time and labor he has arrived. He writes as follows on the Azoic period:

Dr. Bell's views on the Azoic period.

"This great division is so called because as yet no trace of either animal or plant life has been found in it. It is also termed the Archæan period or age. In Ontario the rocks which belong to it may be grouped under the Laurentian and Huronian systems, although other divisions have from time to time been proposed for some of them. These two divisions are considered sufficient by many geologists for the Azoic rocks of the whole world. Without taking local peculiarities into consideration, the primitive rocks of all countries may be classified under one or other of these great systems, even if subordinate divisions should be found convenient in some localities. The characters and proportions of the different rocks which make up the Laurentian and Huronian are naturally found to vary much in different regions, although they are everywhere essentially the same systems and retain the same relative positions, representing similar conditions in the geological history of the globe. They form the foundations of the crust of the earth as far as we can observe or penetrate it, and are easily separable from any rocks lying above them. Their crystalline characters and generally disturbed condition are their distinguishing features. At the same time it is true that, in some instances, newer rocks have been so altered locally or even over considerable tracts as to resemble the Azoic, but we generally find some means of distinguishing between them. In Canada and the United States the Laurentian and Huronian are usually intimately associated, but their lithological features, or the internal characters which distinguish rocks from one another, are sufficiently distinct to separate them. As they are for the most part included in one great area, they must be to some extent described together.

Azoic rocks of Ontario.

"The Azoic rocks of Canada have been represented as extending from the region of the great lakes in the form of two arms, one stretching northeastward to the Atlantic coast of the Labrador peninsula, and the other northwestward to the Arctic sea, east of the mouth of the Mackenzie river, the intervening space being filled up with Palæozoic rocks. Further light on the subject has however shown that the geographical outline of these rocks takes the form, approximately, of an immense ellipse which includes the northeastern part of the continent, Baffinland, Greenland, and many of the islands of the frozen sea. It comprises the whole of the Labrador peninsula, measur

Geographical distribution of azoic rocks.

ing a thousand miles each way. On the other side its boundary runs, with a westward curve, from lake Winnipeg to Coronation gulf, another thousand miles, with a spur towards the mouth of Mackenzie river. The Palæozoic rocks of Hudson bay form a sort of broken fringe around that inland sea, and and a belt of them extends thence northward across some of the islands to the Arctic ocean. The geographical depression of Hudson bay, to which the rivers flow from all sides, forms the central drainage basin of this Azoic area of North America, and its origin is of very ancient geological date. At various periods of the earth's history it was probably covered by waters more or less separated from the outer ocean, and the newer rocks in its centre were deposited from these in the same way that deposits are forming in the bottom of the bay at the present time.

Nucleus of the continent.

"Although the superficial continuity of the Azoic region just described is broken in many places by channels of the sea, and by outlying patches of Palæozoic rocks, it may be regarded as practically one area of compact outline, and it forms the nucleus upon which the rest of the continent has been built. On the east it falls abruptly into the deep ocean, but on its landward sides it is flanked by the formations which have been successfully deposited around it. The farther we recede from it the newer the rocks become, till in one direction we reach the Rocky mountains, which have broken up through a vast thickness of these succeeding strata.

"As a rule, the Huronian rocks are less contorted or corrugated on the small scale than the Laurentian, but on the large scale they partake of the same foldings which have affected the latter. At one time they were supposed to be less abruptly bent into anticlinal and synclinal forms, but this appears to have been a misconception, due to the fact that some of the highest beds happened to have been first studied in a district that is less disturbed than the average. In other localities some of the Laurentian rocks are as little disturbed

"The greater part of the mixed Laurentian and Huronian region belongs to the former, and of it the Lower Laurentian is the prevailing type. As represented on a map, the Huronian occurs in the midst of the Laurentian in the form of more or less completely separated areas, or with straggling connections between them.

A region of mixed Laurentian and Huronian rocks.

"They seem to be in a manner interwoven with the Laurentian as basins or troughs more or less elongated, and as tracts of angular and other forms filling spaces between great nuclei or rounded areas of Laurentian rocks. Patches of Huronian strata of comparatively small size are numerous throughout this vast Azoic region of the northeastern part of the continent, and in addition to these there are a few of great extent. One of them is on the northwest side of Hudson bay, and appears to stretch far inland. Another lies to the north and northeast of lake Huron, reaching from the east end of lake Superior almost to lake Mistassini, a distance of 600 miles. In Wisconsin and Michigan also considerable areas exist, and in the country between lake Superior and lake Winnipeg Huronian rocks of many different basins are largely mixed with

the Laurentian, constituting perhaps one-third of the whole area. In the country between the northern extremity of lake Winnipeg and Hudson bay the writer has described a Huronian trough 180 miles in length, and Mr. A. S. Cochrane found these rocks between the Saskatchewan and Churchill rivers, and largely developed on the north side of lake Athabasca.

"We have given the above brief account of the relations of the Laurentian and Huronian systems to each other, and of the distribution of the two in northeastern America, in order that the reader may the better understand what is to follow in regard to the rocks that occupy the greater part of Ontario as now extended. The country formed by these two systems is sometimes referred to as the Laurentian region, but it is more correctly called the Azoic or Archæan when areas of both classes of rock are included. We shall now proceed with a short description of the Laurentian alone. The Laurentian system.

"As indicated in the table already given, the Laurentian system has been divided into two formations, the lower of which is sometimes also called the Primitive Gneiss series. The differences between them can be best pointed out after having described the Lower Laurentian. Both formations give rise to the same kind of country which is so familiar to all Canadians. As a rule it is hilly, but not greatly elevated above the sea, and full of lakes. Within the regions which have been sufficiently explored to speak of with some degree of certainty these amount literally to tens of thousands, and occupy a very considerable proportion of the whole surface, estimated in some sections at one-third and even one-half of the whole area. The cause of the existence of these lakes will be explained further on. The high northern part of the coast range of eastern Labrador has not been glaciated, but almost everywhere else there are unmistakable signs of this phenomenon. This has given rise to the peculiarity of the Laurentian country which Sir William Logan has so graphically described as mammillated. This vast hilly country however cannot properly be called 'the Laurentian range.' Lower Laurentian or Primitive Gneiss series.

"The Lower Laurentian consists essentially of gneiss. In some localties its foliated or stratiform character is obscure, and it may be called granitic or syenitic. The distinctly banded varieties differ from one another considerably in the proportions of their constituents. True gneiss is defined by lithologists to consist of quartz, felspar (orthoclase) and mica, but most of the gneisses of both the Lower and Upper Laurentian contain hornblende, often in large proportion. These would be called hornblendic or syenitic gneisses. The proportions of these minerals vary constantly, and it is seldom that there is any great thickness having the same composition. One layer may consist chiefly of felspar and quartz, the next may contain much hornblende or mica in addition, while a third may consist largely of any one of these alone. These minerals in fact enter into the composition of all the gneissoid rocks in every conceivable proportion. It is easy for the mere lithologist to select typical varieties of rocks in a good cabinet collection, but in the case of the gneissoid rocks it is impossible for the field geologist to recognize these distinctions on a large scale. In the Lower Laurentian, hornblende is almost as generally diffused as the felspar, quartz and mica. Character of the Lower Laurentian.

It sometimes occurs as bands consisting almost exclusively of this mineral in both the lower and upper divisions. In the latter it has been noticed particularly in proximity to the limestone bands and the iron ore deposits. The Laurentian hornblende rocks are usually blacker and more coarsely crystalline than those of the Huronian system.

Color and form of gneiss rocks.

"The prevailing colors of the Lower Laurentian gneisses are greyish and reddish, from very light to the very dark shades, depending partly on the colors and partly on the proportions of the different constituents. The felspar (orthoclase) is white, gray and red, or sometimes yellowish or greenish ; the quartz is white to gray, and the mica and hornblende black, or very dark green or brown. These rocks are generally distinctly foliated, or show a lamination or parallelism in the arrangement of their constituent minerals easily traceable by their colors. Where these are very distinct and the layers continuous and close together, the rock in cross-section is described as ribboned ; where the layers are further apart it is called banded. But the bars are often broken into a series of tapering dashes which pass below or above each other, or with an interlocking or 'dovetail' arrangement, or the bars may be connected by their streaks or rows of dots. Even where the tendency to parallelism in the texture of gneiss is not conspicuous, from the want of contrast in colors, it can always be seen on close inspection, and this kind of structure or 'grain,' like that of wood, is what distinguishes gneiss from granite, the latter having no such parallelism in the arrangement of its constituent minerals.

"On the supposition that this structure of gneiss, even when the parallel bands of different kinds are quite thick, may be accounted for in other ways than by stratification due to the action of water, some geologists hesitate to speak of it as stratification or bedding, notwithstanding its apparent identity with it.

Foliation and strike.

"As a rule, in Canada the exposed surfaces of the gneiss rocks show little sign of decay, on account of their having been worn down by glaciers in comparatively recent geological times, and they have an extremely massive appearance. When broken up, as by blasting, they fracture almost impartially in all directions ; or show only a slight tendency to cleavage along the plane of their foliation. This foliation in the gneisses of the Lower Laurentian is usually contorted or bent in various directions on the small scale, and any differences in their composition or color do not appear to be sufficiently persistent to trace them far in any direction on the ground ; in other words, they are not so sufficiently differentiated into great bands of distinct kinds as to enable them to be shown on a map of moderate scale, as is often the case with the gneisses and other rocks of the Upper Laurentian. Still, in those areas which have been most examined, a general tendency has been observed to strike more nearly in a northeast and southwest direction than in any other. In eastern Labrador, and also in Baffinland, the larger mountain ridges run northwestward, but it has not been ascertained that this is the direction of the strike of the gneiss in those regions. The monotonous gray and red massive and contorted gneiss above described prevails

throughout the vast Lower Laurentian region, stretching from the great lakes of the St. Lawrence to Hudson bay and thence to lake Winnipeg, as well as in the western and most of the southern parts of the Labrador peninsula.

"In some districts the Laurentian rocks are cut by dikes of greenstone or trap, some of them very large and affecting the geographical features. Rivers or long narrow lakes sometimes lie upon the courses of dikes which had become decomposed and yielded to glacial action, while falls and rapids occur where hard dikes cross the courses of streams. Both the Lower and Upper Laurentian formations are cut by veins of two classes, the first being much more ancient than the second. The former, which are numerous, are as it were fused into or amalgamated with the country rock and are composed of the same minerals. In some cases the gangue is almost entirely felspar, in others quartz, but oftener the two minerals are mixed together and a little mica or hornblende is added. The larger veins of this class are very coarsely crystalline, the smaller ones have a tendency to branch off or become reticulated. Although the division between them and the wall rock is distinctly defined by the contrast of color, there is no actual separation between them, the two breaking like one rock. Metallic ores have not been found in these veins in economic quantities. Veins of this class may be seen in almost any locality where the gneisses are exposed. The veins of the second class are not so common, and have been formed long subsequent to those of the first class. Their gangue, which is frequently calcspar, separates easily from the wall rock, and is apt to contain galena, copper and iron pyrites and zinc blende; but these minerals, like the vein stones themselves, have perhaps been derived from rocks resting on the gneiss, or which rested upon it at some former period when these veins were formed, but which have since been removed by denudation. The lead-bearing veins of the counties of Frontenac and Leeds, and those north of the Canadian Pacific Railway opposite the head of Black bay, lake Superior, are examples of the second class. With the exception of the contents of veins of this class and the coarsely crystalline felspar and quartz of those of the first class, no minerals of economic value are known to occur in Canada in the Lower Laurentian formation or primitive gneiss series above described."[2]

Dikes and veins in the Laurentian system.

Minerals in the veins.

The conclusion arrived at by Dr. Bell, namely, that with rare exceptions "no minerals of economic value are known to occur in Canada in the Lower Laurentian formation or primitive gneiss series" shows: 1, How essentially necessary it is that the country rock shall be of a favorable description if we expect to find minerals of economic value; and 2, that there is no reasonable ground for the hope that the prospector will be able to do so, whatever time, labor and money he may expend in the search, if the country rock is Lower Laurentian or primitive gneiss.[3]

Dr. Bell's conclusions.

[2] Report of the Commission on the Mineral Resources of Ontario, pp. 6-10.

[3] In the Summary Report of the Geological Survey for 1895, p. 18, Director George M. Dawson says, after referring to the Lake of the Woods and Seine River mining regions: "From a still wider point of view, embracing the nickel, copper and gold deposits of the vicinity of Sudbury and Sault Ste. Marie, as well as those above particularly referred to, the economic importance and metalliferous character of the rocks of the Huronian system become even more apparent. This fact was recognized and the importance of the geological conditions insisted upon by Sir William Logan, in Reports of the Survey made nearly forty years

Now the provincial territory lying on the north side of the Canadian Pacific Railway from White lake, or say Trudeau station to Missinaibi station, a distance of nearly one hundred miles by the line, is in the opinion of the writer almost entirely Lower Laurentian, and he agrees with Dr. Bell in thinking that few if any minerals of economic value are likely to be found in that formation. This opinion is not based on a thorough and exhaustive examination of the country, but upon what he has seen of the character of the rock where exposed on White lake, the upper White river, Esnagami or Shell lake, Wabatonguishene lake, Dog lake, Cross lake, and lake Missinaibi, and as presented to view in various cuttings on the railway. All of these mentioned are large lakes, varying from ten miles to twenty-five miles in length, and proportionately wide. The boulders in the gravel pits and elsewhere on the route were repeatedly examined as also likely to afford more or less reliable indications as to the character of geological formations north of the railway.

A region of Lower Laurentian.

The inference drawn from all these various sources, together with information obtained during former explorations, is that between the points mentioned, namely Trudeau and Missinaibi stations, there are no areas worth mentioning of Huronian or other more favorable formations within fifty miles or more on that side of the track.

To have taken notes with the view to furnishing details of the position, strike, dip and so forth of rocks apparently so unpromising, if not altogether barren, would have been simply a waste of time and labor, and of no interest or advantage whatever to either prospectors or miners. Specimens however were taken showing the general character of the country. It will be seen that hornblendic or syenitic gneiss greatly predominates over other varieties, and that the hornblende exists in all proportions, from small scales until in some instances the rock is almost entirely composed of it.

The inference from the geological facts.

Crystalline limestone, which Sir William Logan considered to be so characteristic of the Laurentian system in eastern Canada, was nowhere met with. Its occurrence in any considerable body interstratified with gneiss must, the writer presumes, be confined principally if not entirely to what is now called the Upper Laurentian formation, in which, when not itself metalliferous, it appears to exercise a very beneficial influence on the metal-bearing character of the neighboring gneissoid, trappean or other rocks associated with it, as well as by its decomposition greatly enriching the soil.

In the few small patches of Huronian rocks represented on the maps of the Geological Survey as found in the area under consideration, none of those seen by the writer are of a kind which within his experience have been productive.

Thus it appears that the country rock or geological formation of this part of the Province is not such as to encourage the hope that its mineral resource will prove of any value or importance.

ago, and it is gratifying to observe that the practical miner is now beginning to appreciate the value of a large amount of geological work carried out in the country to the north of the Great Lakes, which a few years ago it might have appeared difficult to justify in the ligh of any economic results up to that time achieved. There can now be very little doubt tha every square mile of the Huronian formation of Canada will sooner or latter become an objec of interest to the prospector, and that industries of considerable importance may yet b planted upon this formation in districts far to the north, or for other reasons at presen regarded as barren and useless."

But desirable, even indispensable, as a favorable country rock may be, it is not everything. In order to the existence of metallic ores or other minerals in paying quantity, there must be veins or other openings in these rocks in which the ores and minerals, wherever they come from, may be deposited. These veins, too, must be sufficiently large and regular. There are thousands of square miles in this and other countries where the rock is all that could be desired; but in which, owing either to the entire absence of veins or to the smallness and irregularity of such as do exist, not a single workable deposit of the economic minerals commonly found in these rocks elsewhere has been discovered.

The absence of regular veins in the region.

This absence of powerful and regular veins can only be accounted for on the supposition that the forces which have produced mineral veins in some countries have been inoperative in others in which, although the geological formation may be the same, such veins do not occur. A few words therefore on this subject may not be out of place.

What then are mineral veins and how have they been formed?

MINERAL VEINS, AND HOW FORMED.

Veins and dikes.

Veins may be defined as fissures of uncertain length, width and depth, filled with mineral matter differing in appearance and composition from the enclosing, or as called by miners the "country rock." Thus there are veins of calcareous spar, quartz, barytes, fluorspar and such like, alone or combined with other minerals. If metals, native or in the condition of ore, should occur in the veins along with one or more of the spars mentioned, they are usually characterized as gold, silver, copper or lead veins, however small the quantity of metal may be as compared with that of the gangue or associated stony minerals. When however the fissures are filled entirely with stony matter, such as greenstone, trap, porphyry, basalt, etc., supposed to be of igneous or volcanic origin and to have been injected from below in a molten state, such fissures are usually called "dikes" and not veins.

Origin of fissures.

The question of how these fissures in the rocky crust of the earth have originated is one of more than passing interest. They are usually ascribed to one or other of three causes, viz.:

1. The contraction or shrinkage of the so-called igneous and metamorphic rocks in the process of cooling.

2. The contraction or shrinkage of the sedimentary rocks in the process of drying and of consolidation.

3. The elevation or depression of the earth's surface by volcanic disturbances, which when sensible are called earthquakes

Contraction as a cause.

As regards the first mentioned cause of fissures in the rocky crust of the earth, it is a well known general law that with a very few exceptions all bodies, whether in a solid, fluid or gaseous condition, expand when heated and contract when cooled. The expansion and contraction of iron in its solid condition is seen in the way and manner in which the tires are put on carriage or other wheels. That of fluids is illustrated by the mercury and alcohol in the bulbs of our thermometers. And the expansion and contraction of vapor and gas under like circumstances is manifested in the case of steam. Thus, on the

assumption that the Azoic or Archæan or old time primitive rocks, which include our Laurentian and Huronian systems, have been at one period of the earth's history in a highly heated and expanded condition, fissures or veins would certainly be formed in these rocks as they cooled and contracted; and it is to this cause probably that many both of the veins and dikes met with in these rocks owe their existence.

The formation of veins as a consequence of the shrinkage of sedimentary rocks in the process of drying and consolidation may be witnessed almost everywhere, on a small scale during periods of drouth, in the sediments at the bottom of dried up pools and other places. It is strikingly exemplified in the calcareous mud deposits on the coast of James bay. Small veins and strings may have originated in this way in some of the sedimentary rocks, but few if any would be likely to extend to any great length or depth, nor to penetrate successive beds of rock widely differing in mineral composition and character.

Volcanic disturbance as a cause.

The largest and most powerful veins and dikes wherever found, and in whatever formation they may be situated, owe their existence, in the writer's opinion, to volcanic disturbance or agencies. The tremblings, undulations and shocks caused by the action of volcanic forces on the so-called solid crust of the earth must of necessity produce great fissures in all parts of this crust not in a soft or plastic condition. A like result would follow from any considerable upheaval or depression of the surface of the earth, to whatever cause it might be due. During more or less violent earthquakes the opening of great cracks in the earth has often been witnessed and recorded. Whether in length, depth or width, it is reasonable to suppose that fissures (whether dikes or veins) thus formed must be greater in every way than those which owe their existence to either shrinkage or contraction.

Up-throws, down-throws and lateral slides.

Subsequent undulations, though much less violent than those which first occasioned the fissures, would, the writer believes, unquestionably tend momentarily when crossing such fissures to elevate or depress one side or wall of the fissure or vein before or after the other, and thus occasion an upward and downward movement. Nor is it difficult to conceive that when the direction of these subsequent undulations was other than at right angles to the course or bearing of the fissure, an irregular lateral motion or shifting of the walls of the enclosing rock may have been occasioned, with a tendency at least to produce what are called up-throws and down-throws of the opposing walls, as well as lateral slides in such veins. The polished surfaces exhibited by the walls of some veins, known as slickensides, may possibly be in some measure due to this cause.

Slickensides.

Similar effects produced upon lake ice.

The writer has been led to consider such movements of the rock possible by those he has observed as taking place in the great fields of ice on lakes Huron and Superior under the influence of undulations caused by the action of strong wind on the vast unfrozen body of water outside. These undulations when crossing the larger cracks or fissures produce on a small scale such movements as are here referred to.

Fissure veins and bedded veins.

Veins are further divided into two classes: (1) those which cross the formation, if stratified, at a greater or less angle, known as true fissure veins; and

(2) those which are interstratified with the enclosing rock and called bedded veins. The writer's mining knowledge and experience has been mostly acquired in working true fissure veins. As regards bedded veins he does not claim to speak with the authority of an expert who has spent the greater portion of his life in searching for and mining the ores which on this continent are so frequently found in veins of that character. For information on this and other less frequent forms in which ores are deposited, the writer would refer to the valuable and interesting paper by Dr. A. P. Coleman pp. 50-53 in last year's Report of the Bureau of Mines.

In the territory which forms the subject of this report no true fissure veins worthy of the name were met with. There is abundant evidence that the forces which elsewhere produce such veins have been in a state of activity, and that great cracks or fissures have been produced—fissures both crossing and running with the strike of the Laurentian gneiss. But no sooner had these fissures been formed than they were apparently filled again with stony matter from below, called trap, as destitute seemingly of economic minerals and metals as the gneiss rock itself. These enormous fissures would appear to have penetrated through the then possibly thin crust of the earth to the underlying molten matter, and this has been forced up or probably has risen to the surface, filling the fissures in much the same manner as water rises and fills cracks in the ice. The number and magnitude of these trap dikes, and their presence interbedded with gneiss and otherwise, is one of the most striking geological features of the territory. But their presence does not in the writer's opinion help to redeem the generally barren character of this Lower Laurentian formation of which they are simply a part. Trap dikes.

Thus we arrive at the conclusion that whether from the point of view of character of the country rock, or from that of the existence or otherwise of mineral-bearing veins, the territory referred to is not in the opinion of the writer such as offers a promising field for the enterprise of either the miner or prospector. The region an unpromising field for minerals.

SOUTH OF THE RAILWAY LINE.

Our explorations south of the Canadian Pacific Railway were limited and confined to a few small areas near White River station and Missinaibi station. In the former the rock is Laurentian, and similar to that on the north side of the line. South of the line, at Missinaibi, the country is represented on the map of the Geological Survey as Huronian, with the exception of a few patches on Dog and Mattagaming lakes and extending all the way to lake Superior, thus embracing a large area. Of this the writer can say little, excepting that the rock, in his opinion and so far as he has seen it, is more favorable to the occurrence of minerals of economic value than the Laurentian gneiss so prevalent on the north side of the railway. It differs however in character from the Huronian rocks at and in the neighborhood of the Bruce Mines, with which group he is most familiar. A good deal of exploratory work was carried on at and in the vicinity of Michipicoten thirty or more years ago, particularly by a Mr. Johnstone of Detroit. This gentleman took up a number of mining locations which he believed to be valuable

At White River and Missinaibi stations.

A Huronian area of greater promise.

Prospecting near Michipicoten

for iron and copper. He manifested the sincerity of his belief by spending all his money in prospecting them, and died in that faith about the year 1869 or 1870. There has been more or less prospecting carried on at various times since, but little or no money spent in development to the writer's knowledge. Since the construction of the railway the Huronian rocks on and around Dog lake have been partially exploited by prospectors and some little work has been done on one or two locations, but not, it is thought, with any satisfactory results. He has himself noticed copper (pyrites and green carbonate) in several places, but the veins were small and neither well-defined nor regular. He has been told that nickel has been discovered, and has seen specimens of galena and good iron ore, said to have been got between Dog lake and Michipicoten.

and around Dog lake.

It will be noticed that John Driver, on his return from Missinabi to Michipicoten, found several veins which he thinks deserving of a more thorough examination.

Further exploration desirable.

Copper pyrites so frequently accompanies gold in greater or less quantity that it has more than once occurred to the writer that some of the veins on poor Johnstone's locations, though worthless for copper, might be found on careful examination to contain the far more precious metal.

In view of his limited and imperfect examination and knowledge of this part of the Province, the writer does not feel justified in expressing any strong or very decided opinion in reference to its mineral resources, nor yet as to its affording a desirable field for the prospector. Where however it is so easily accessible he would incline to favor further careful exploration of the country between Michipicoten and Dog lake.

No prospect of placer gold

There does not appear to be any probability of placer gold being discovered on this portion of the height of land plateau, certainly not in paying quantity. The rocks of the Lower Laurentian formation would appear rarely, if ever, to contain gold, and there are no Upper Laurentian or Huronian rocks known to the writer within a great many miles north of the line of the C.P.R. If such there be, the areas are inconsiderable. The decomposition of these Lower Laurentian rocks is very slow, and has produced little soil or other loose material. The far greater proportion of the sands, gravels and clays deposited on this and most other parts of the height of land plateau is the result of glacial action, and the material has been chiefly furnished by the comparatively soft sandstones and limestones of the broad belt of palæozoic rocks bordering upon and south of James bay. In drift deposits of this character there is no likelihood whatever of gold being found.

There is a possibility that traces at least of gold may be discovered in the sands and gravels of some of the rivers flowing into lakes Huron and Superior and passing in their course over Huronian or other gold bearing rocks. But the writer has not heard of gold having been found on either the north or south shores of these lakes, in the sands or gravels of the rivers. Had it been discovered in anything like paying quantity, the fact would have been published far and wide. 'Prospected' as they have doubtless been, there is no probability of its occurrence otherwise than in very small and unremunerative quantity.

BEYOND THE HEIGHT OF LAND.

As related in the first part of this report, an apparently large deposit of iron pyrites was discovered by the writer ten years ago on a tributary of the river Opazatika, misnamed Big river, but which is in fact ordinarily an exceedingly small one. It may have a better claim to the title during the melting of the snows in early spring, when all the northern rivers are greatly swollen. In view of the value of and increasing demand for pyrites the writer, unable to go himself, sent John Driver to uncover and ascertain the size of the vein (as it appears to be), to put in a few shots, and bring back specimens of as large a size as he could get. This mission he accomplished in a very satisfactory and creditable manner, and his report on this deposit and on an apparently important discovery made by himself at the Split Rock rapid on Missinaibi river is as follows : Opazatika river

"On August 8th Mr. Borron decided to go down to the Big river, a tributary of the Opazatika. After getting supplies and other things necessary for the journey we left Missinaibi Post at 2 p.m., crossed the height of land at 5 p.m., and as Mr. Borron was not feeling well we camped early. The next day an early start was made, as the morning was fine and there was no wind. The water on Missinaibi lake was smooth, so we reached Brunswick Post of H. B. Co. at 5.30 p.m. and camped for the night. Next morning Mr. Borron came to my tent and said that he was unable to travel, but if I would go on and get the specimens he required for the Government he would return to Toronto, which I agreed to do. After making the necessary preparations and receiving instructions from Mr. Borron, I started out for Big river on the 12th. We followed the Missinaibi down to the Opazatika portage, which is in a straight line northeast 40 miles, and thence crossed over to Opazatika lake, which is 3½ miles south of Missinaibi river. From the west end of Opazatika lake to the junction of the Big river is 42 miles northeast, so that the distance over all in a straight line from the southwest end of Missinaibi lake is 91 miles, including 5½ miles up the Big river, to the pyrites bed or vein. Having looked over the vein, which I had no trouble to find, the next work was to cut out a path or road on the south bank down to the camp, a distance of 1½ miles. Next morning was gloomy, as it rained all night. We uncovered the rock along the south bank the full width of the bed of pyrites, which is 35 feet from wall to wall. I put in two shots, which broke up the vein rock two feet deep, from which I got specimens. I then uncovered the rock one hundred feet back from the bank and found the vein covered over with a foot of sandy loam. My men uncovered the vein from wall to wall, and I found it to be 35 feet wide. The course N. W. 20° W. and at an angle of 65° E. In tracing the vein south I found it to be deeply covered with soil. The rock gradually rises in going back from the river, and at 300 yards is about 20 feet above the water level of the river. John Driver's report to Mr. Borron. A pyrites deposit on Big river.

"When Mr. Borron explored Big river in 1886 he thought that the rock in the river was a boulder, from which he got his specimen. But I found it to be part of the vein, 15 feet wide and two feet above the water. It crosses one-third of the river on the south side about 200 yards up stream. The river here takes a bend to the south and comes back on itself, so that in following the course of the vein on the north side it cuts across this point of land, which is a drift soil. I could not uncover the vein, as the water soaked through the ground and made uncovering impossible. However in following up the course I found the vein to crop out at the foot of the rapid on the south side of the west branch, at the forks of the river half a mile northwest from the place where I had been working. Here the rock is deeply covered with a stiff clay. I got the men to clean off the part of the vein and took what specimens I could break off with my pick hammer. From the surface the pyrites at this place does not look as good as at the lower place, although I am quite sure it is the same vein. The rock is so deeply covered with a clay soil that I could not follow it any farther, but no doubt it continues on for a much farther distance northward. In following up some 300 or 400 yards, I found that the country rock took a change, being on the west side of the vein Laurentian, while on the east side and all the way down the river to the first rapid it is a slate, what I take to be a Huronian. Tracing the deposit.

Timber and forest fires.

"The timber on Big river is chiefly black spruce and tamarac, and the soil clay loam. One thing I noticed is that the Indians who hunt on this river are careful with regard to fires, as the country as far as I could see has not been run over by forest fires, whereas on the Opazatika river as far as I could see from the river, the country was all run over with fire some four or five years ago.

"After picking up my specimens I started on 20th August back up the Opazatika river, examining the rocks as I came along, but could not find where the pyrites bed on Big river crosses the Opazatika. The water in the river is deep and no rocks could be seen or found, not even in the river bed. But coming up the Sawbill falls I found that the rock which forms this falls is Laurentian gray granite, and the same continues all the way up to the Sharp Rock rapid. At this rapid the rock changes to Huronian slate. The distance from Sawbill falls to the Sharp Rock rapid is nine miles, showing this Laurentian band to be of about that width. It runs out to a point southward, and the Huronian rock to a point northward. The Laurentian granite is again met with at the west end of Opazatika lake and follows up the river. At the head of the first rapid met with in going down the river there is a diorite dike about fifty feet wide, running northeast and dipping south. On the south side of this dike is a large vein of magnetic iron running the same course as the dike. I did not examine this deposit, as I had no provisions to allow me time to do so. I was informed by the Indian guide that it is traceable for a long distance on the north side of the river.

Magnetic iron ore.

A large vein at Split Rock rapid.

"Coming up to the Split Rock rapid, I observed the rock to be discolored and covered with iron rust. I found it to be a large bed of iron and arsenical pyrites, from which I took specimens. I put two shots in on the vein and found it to be fifteen feet in width. It crosses the river at the foot of the rapids and dips 60° east. I followed the vein southward 200 yards with no change; it looks very promising, and I think would pay to test for gold. The vein is traceable for a long distance on the north side of the river also; and as the rocks are not covered with soil the vein is easily got at." [4]

Use of iron pyrites in manufactures.

Iron pyrites when in large bodies, such as described by Driver in the foregoing report, if not too much mixed with quartz or other gangue matter, is valuable. Very great quantities of it are used at what are known as alkali works in Great Britain and elsewhere. It is employed by alkali manufacturers on account of the large proportion of sulphur it contains, and as a substitute for Sicilian sulphur. If not immediately, pyrites cannot fail in the near future to become valuable on this continent, and will ultimately be required for alkali works in our own Province of Ontario, which possesses all the elements necessary for the successful manufacture of the products of such works. The more important of these products are sulphuric acid or oil of vitrol, muriatic acid, soda, soda-ash and bleaching powder (chloride of lime). All these articles are extensively required and employed in many of the most important arts and manufactures, such as bleaching, glass-making, paper

[4] A number of the samples of rock and ore collected by John Driver were submitted to Dr. Coleman of the School of Practical Science, two of which he examined under the microscope and five of which were assayed under his direction by Mr. W. E. Boustead.

A sample from Sawbill falls on Opazatika river is described as "a medium grained gneiss or granite, light gray in color, with a somewhat schistose look. Under the microscope it proves to consist chiefly of quartz, orthoclase, plagioclase and biotite, with a little secondary epidote." Another sample from the same locality is "a somewhat schistose fine grained gneiss, with bands of gray and brownish red. It consists of quartz, much weathered felspar and hornblende." Following are the results obtained by Mr. Boustead:

Sample from Opazatika lake. Massive iron pyrites, with some intermixed quartz. Contains neither silver nor gold.

Sample from Split Rock, Missinaibi river. Schistose rock impregnated with pyrrhotite, very much weathered. Contains a slight trace of gold.

Sample from foot-wall of pyrites vein at Split Rock. Quartz somewhat stained with oxide of iron and carrying iron pyrites. Contains neither silver nor gold.

Sample said to be from vein at Split Rock rapids. Quartz with felspar, iron pyrites and molybdenite, stained with oxide of iron. Contains a slight trace of gold.

Pyrites from Split Rock rapids. Massive pyrrhotite with intermixed quartz. Assayed for nickel and found to contain none.

pulp, baking powder, and others too numerous to mention. The materials most essential are salt, lime and sulphur or pyrites. Fuel and labor of course are important factors. In most if not all these respects our Province is very favorably situated in regard to the establishment and successful operation of alkali works. The residue of the pyrites after sublimation of the sulphur is often of considerable value, containing, as it frequently does, more or less gold, silver or copper. The deposits of iron pyrites referred to are well deserving of further examination with a view to determining their extent and value.

SOME GENERAL CONSIDERATIONS.

The labor, time and money the prospector expends in the vain search for minerals in localities where there is little if any probabilty of such being found, is simply waste, and should be minimized or guarded against as much as possible. Nor is it in the interest of the prospector or miner, nor yet of the Province generally, that the labor and capital which might have sufficed to develop the mineral resources of some more favored section of the Province or profitably employed otherwise, should thus be literally lost.

Interest of prospectors, miners,

There are many who fancy that if the capital thus expended be foreign capital all classes must be benefited, however disastrous the results may be to foreign investors. The writer fails to see it in that light. That a few individuals may benefit by expenditures of this kind, however ill-advised and unprofitable, cannot be denied. Employment for a time is provided for miners, laborers and mechanics; a convenient market for some kinds of produce may encourage settlement and farming in the neighborhood of the mine—poor though the soil may be; stores may be erected and churches and school houses built, and most likely taverns if not hotels. But these seeming advantages are lost when the collapse comes, as it surely does when the mine shuts down and operations are suspended.

workingmen

The workingmen who, many imagine, would be most generally benefited are not infrequently the greatest sufferers. Unsteady and precarious employment is the bane of the workingman, be he miner, laborer or mechanic. These men have for the most part probably come long distances, at great expense, in the hope of steady employment. They must now go elsewhere to seek and possibly be unable to obtain work for weeks or months. If they have been tempted to build cottages and make homes for themselves, these must be abandoned and sacrificed. Thus the apparent advantage of a few months' or even a few years' employment is in many if not most instances entirely lost by those who are supposed to be benefited the most.

Then take the case of the farmers who have been induced to settle in the vicinity of such a mine. They build and clear and fence, and for a time rejoice in a good market for their produce. But the farmer like the workingman is doomed to suffer disappointment, if not positive loss. For if the soil be poor, which is not unlikely, and other markets remote or inaccessible, which is also probable, the suspension of the mine compels him to either abandon his farm and all his improvements, or to be content with hard work and a bare sufficiency of the necessaries of life.

and farmers.

The influence of mining booms.

It may be contended that booms, however originated, and however disastrous to the foreign capitalists who may be induced to purchase and work mines of little or no promise, may nevertheless be of great advantage to the Province if they only enable the Government to dispose of large quantities of wild land which otherwise might not be sold for many years. This is a heresy which it may be dangerous to combat, and difficult to dispel. But when we consider, as we should, that by far the greater part of the money received from the sale of mineral lands during periods of excitement comes out of the pockets of our own people, that many of these (who were or are engaged in other pursuits) have been crippled if not ruined in consequence, it will, the writer thinks, be admitted that it is at least doubtful whether it might not have been better had the money thus locked up remained in the legitimate business of the unfortunate speculators, and the land itself in the possession of the Crown.

While prosperous and dividend-paying mines are the best and most trustworthy evidence as well as advertisement of the mineral resources of the Province, and sure to attract capital from abroad, so on the other hand repeated failures and disasters have precisely the opposite effect. The country in which this occurs cannot fail to acquire, sooner or later, an unfavorable reputation, capital will seek investment elsewhere, and mining claims and properties of the greatest promise will fail to attract it, and probably remain undeveloped for many years.

Hence it is important that the Bureau of Mines should be in a position to direct the attention alike of prospectors, miners and capitalists to those parts of the Province which in the opinion of practical and disinterested men are really most promising, rather than to those less promising or altogether worthless.

Viewed in this light the writer hopes that the work of last season, interrupted and shortened as it was by illness, and expended on what for the most part appears to be an unpromising mineral region, may still be of greater or less value to the Province, and to those interested in the development of its mining industry.

Respectfully submitted,

E. B. BORRON.

Toronto, March, 1896.

SIXTH REPORT OF

THE INSPECTOR OF MINES.

REPORT OF THE INSPECTOR.

To the Director of the Bureau of Mines:

Sir,—I have the honour herewith to submit to you my sixth Annual Report on the mines of the Province of Ontario, being for the year 1895. Letter of transmission.

Several classes of the mines have been lying idle during the year, viz: Iron, silver, copper and phosphate, while only to a limited extent have the mica mines been worked. Some nickel mines were also closed down.

Your extended visit to the mines throughout the western part of the Province, the account of which will appear in your own report, rendered it unnecessary for me to duplicate their inspection, not only to avoid expenditure, but especially as the majority of these mines were not being worked on an extensive scale nor at great depth. These causes will account for the limitation of the present report.

The recent construction of the large iron furnace at Hamilton, which is now in full blast, will in all probability be the means of causing some of the owners of large iron deposits to open up their properties with the prospect of obtaining this market for their ores.

The increased activity in gold mining during the year appears unabated, and was attended with such encouraging results that the coming season may be regarded as one of much more promise than any former one, and an increased output from both the iron and gold mines may be expected.

I have the honour to be, Sir,

Your obedient servant,

A. SLAGHT,

Waterford, March 14, 1896. Inspector.

GOLD.

The Creighton gold mine was lying idle at the date of visit to the locality, October 31st. Mr. J. R. Gordon, who had the former charge of the mine, informed me that during the year drilling over a section contiguous to the shaft had been done to the distance of 1,500 feet. Six or seven bores had been put down to the varying depth of 300 to 500 feet, and in each case the auriferous vein was intersected. The result of the operations has been most satisfactory, placing the existence of a large deposit of gold ore beyond contingency. The shaft has reached the depth of 200 feet, and the ore is free milling. The machinery at the mine, details of which appeared in a former report, has had some addition made as required for use and the whole plant is kept in a carefully protected state. It is expected that the Company will renew operations at the mine at an early period. *Creighton Mine.*

The Gordon Mine.

On May 21st the Gordon mine was visited. It is situated on lot 6 on the third concession of Rathbun township, and one mile south of Boland lake, which has its outlet into lake Wahnipitae. It is near the winter road cut out by the Crystal Gold Mining Company. Four men were engaged in sinking a shaft 14 by 16 feet, and had reached a depth of 25 feet. The formation was firm, and no timbering was required. Drilling was being done by hand and the rock lifted by windlass. There was a considerable inflow of water. It was expected to reach the auriferous quartz rock at a depth of about 40 feet. A domicile 14 by 16 feet had been erected for cooking and sleeping, which, with a blacksmith shop and tent, comprised the buildings. Late in October I met Mr. Gordon in Sudbury, and he informed me that the shaft had been continued to a depth of 40 feet, and the property had been further tested by the use of a diamond drill; 120 feet east of the shaft a bore had been put down at the angle of 70° on the dip of the vein, which had been tapped at the depth of 174 feet. One hundred feet further east another bore had cut the vein at about the same depth. Prospecting had been done with encouraging results on several other properties in this immediate vicinity during the summer.

Sinking a shaft,

and prospecting with a diamond drill.

The Crystal Mine.

The Crystal mine is on location W.D. 43 in the township of Rathbun, comprising 26 acres held in fee simple by the Crystal Gold Mining Company of Rathbun. Capital stock, $1,000,000, in shares of $100 each. Hon. Peter White is president, and Mr. W. R. White secretary-treasurer; both are of Pembroke. Gold discovery was made on the property in 1892, on the height of land between lakes Wahnapitae and Matagamasing. The first discovery was on the southeast side of the escarpment, 48 feet below the entrance into the shaft. Another outcropping was found on the top of the hill, and a vertical shaft 4 by 7 feet was sunk on this vein, following it down 36 feet, when the vein left the shaft with a dip northeast. The shaft was continued in barren diorite to the total depth of 100 feet, and neatly cribbed to near the bottom. A northeast drift had been run in at the bottom of the shaft to intersect the vein, and had been extended 25 feet at the date of my inspection, May 20th and 21st. A south drift at the bottom of the shaft had been run in 10 feet, and was being extended with a view of tapping the vein first discovered. The work was being done under the direction of Mr. Rinaldo McConnell, of Mattawa, managing director, and Capt. Allan McDonald had charge of the mine work with a force of 10 men employed on day shifts only. The ladders were placed perpendicularly in the part of the shaft walled off for this use. I directed that they be changed to an incline, with suitable rests, as the regulations in the Mines Act require. The rock was being lifted by the use of a horse whim, which was working properly and provided with brakes, etc. The bucket would hold about half a ton. Guide timbers were being put in the shaft for the future use of a cage.

Exploration work by shaft and drifts.

Buildings.

The shaft house, 24 by 30 feet, was also being used as a blacksmith shop, which I advised should be placed in another building, to avoid danger of fire. The sleeping camp is 20 by 64 feet. Office, store room and laboratory are under one roof. Stabling, hay shed, etc., are also provided. The

whole outfit is kept in a neat and excellent condition, and the scenery is picturesque and inviting. Exceedingly rich specimens of gold ore are found on the property.

The Mondoux Mine.

The Mondoux property on lot 5 in the fourth concession of Rathbun had been opened about one year previous to my visit, on May 21st, by an open cut 8 by 20 feet and from 10 to 15 feet in width, with cross-cutting. Surface stripping had extended along the vein for 60 feet. The quartz, I was informed, showed a good percentage of gold.

The Ledyard Mine.

Progress of development work.

The Ledyard mine was lying idle at the date of my visit, September 17th. Mr. W. G. Yeoman, of Toronto, was left in care of the property for the owners. Since last inspection the shaft had been sunk to a greater depth of 15 feet, making total depth 75 feet. A stope on the vein had been made at the first level, extending 25 feet east and raised to the surface. All the vein matter had been removed between the hanging and foot walls. The ladder-way down to the first level had been properly walled off from the part of the shaft used for hoisting the ore. A new Huntington mill had been put in in place of the old one, with capacity of twenty tons daily. The mill building had been strengthened by additional sills and other supports, so that it is now well fitted to stand all strain of machinery when in operation. No other changes of importance have been made since the former report Work had been conducted at intervals during the early part of the year both at the mine and mill, but has been suspended since the middle of June. Early in December last the management of the mine was placed in the hands of Mr. A. S. Brooks, of Marmora, who had put it in excellent condition for future operations. About 200 cords of wood were on hand. The property has been well looked after by the caretaker, Mr. Yeoman, who has resided at the mine since work was discontinued.

Prospecting in Marmora.

Mr. Peter Powers was doing prospect work with a few men on lot 14 in the tenth concession of Marmora, comprising 100 acres, on which he has taken an option with right to purchase for an English Company. The work on September 18th consisted of several open cuts along the vein to the depth of a few feet, exposing ore of free gold, apparently of excellent richness.

Mr. Donald Clark of Marmora has opened a property adjoining the Deloro mine, owned by the Canada Consolidated Company. A shaft has been sunk 30 feet, opening the vein to 5 feet in width. Fine specimens of ore have been taken from the bottom of the shaft. An option with right to purchase has been taken on 5 acres.

Malone Mine.

On September 18th I met Mr. H. E. Lawson, M.E., at Malone, who was then engaged in treating 100 tons of mispickel ore for the Crescent Gold Mining Company of Montreal as a test to determine future operations. The ore was obtained from a shaft which had been sunk to the depth of 60 feet on the southeast half of lot 6 in the eighth concession of Marmora, being about five miles south of Malone. The company hold an option on the property, and should the test prove satisfactory the mill at Malone may be removed to the mine and active mining carried on. The mine was lying idle meantime. The value of the gold ore being tested was about $12 per ton as

by mill run. The chlorination process was being adopted for the extraction of the gold only. The pulverized ore was roasted in a reverberatory furnace, which had been temporarily constructed for the test. It was then treated in tubs with a current of chlorine gas. The chloride is leached out in the tubs with water and the gold precipitated as metal by the addition of iron sulphates. The precipitate of gold collected and melted was said to give a yield of about 98 per cent. of gold. The test was not completed at the date of my visit, but I understand that it has proved satisfactory to the company and that extensive operations will be carried on as soon as the spring time will admit.

Testing mispickel ore by

Deloro Mine.

The Deloro mine is out one mile from Marmora station on the Central Ontario Railway, and is owned by the Canadian Consolidated Mining Company. In September I met on the property Mr. Thomas Benfield, of Newark, N. J., in company with Mr. Alfred I. G. Swinney, of London, England, and Mr. R. H. Harland, public analyst to the Greenwood Board of Works, whose laboratory is at 37 Lombard St., London, E. C., specialists, who were examining the mine and making tests of the value of the ores. Mr. Benfield informed me that he had recently taken a lease on royalty of the property from Messrs. Stephens and Newberry of Detroit for a period of twenty years, and should the examination of the ore prove sufficiently satisfactory the mine would be vigorously worked on a large scale. Mr. Benfield, with his friends, intended to remain some time in testing the property and also to examine other producing mines with a view of purchase. In a recent letter from Mr. D. Clark, of Marmora, he says: "Mr. Benfield has bonded some 6,000 acres of land in this township with the intention of prospecting and testing them during the coming summer."

Bonding properties

Mine.

On September 18th I visited the Bannockburn mine, which is on lot 28, in the fifth concession of Madoc, near the station of Bannockburn, on the Central Ontario Railway. The village at the station of the same name contains a population of from 150 to 200, with about 40 residences, a hotel, two stores, schoolhouse, etc. The discovery of this mine was made several years ago, and a considerable amount of development work was done on it, together with the erection of a ten-stamp mill and an outfit for treating the ore. Soon after all operations ceased until August, 1894, when the property was leased with the option to purchase by Messrs. F. Straith Miller, of Toronto, and F. S. P[illegible]nchot, of Buckingham, Que. Mr. Miller immediately took charge of developing the mine, and the work has steadily progressed with favorable results, with the exception of three months suspension during the winter. He also refitted the mill, which is well supplied with water, as it is built on the bank of the Moira river within a quarter of a mile of the station; the workings at the mine are about 300 yards from the mill, with an excellent road over which to haul the ore. The work at this date consists of stripping the vein and blowing it open for 700 feet and sinking four shafts at different points of the respective depths of 26, 30, 45 and 30 feet. In the deepest shaft, 32 feet down from surface, a drift 6 by 7 feet has been driven in west 17 feet; the main opening is north and south. Several minor shafts or pits

Extent of the workings.

have been sunk along the workings to the depth of a few feet. The vein, which consists of three main stringers in a band or fissure of micaceous and calc schists, has been exposed to an unbroken length of 700 feet. It is also accompanied by a granitic band which alternates with diorite and forms a foot wall of the fissure, the hanging wall being more or less of mica and calc schists. Between the stringers bands of schist rock are met, which cut out as the bands come together and meet again as greater depth is attained. In sinking, several of the stringers are already united and become auriferous as they join the western vein. The veins of small width at surface invariably increase as they go down and form one vein of auriferous quartz along the entire length of 700 feet of working. From the surface to the deepest workings gold is found by panning, and is visible in the quartz, and numerous specimens were shown to me some of which contained several dollars worth of gold. A single specimen taken from the north pit contained $15 worth, and some from the Lee pit were of much greater value. In the south pit specimens are found varying from $1 to $8. Numerous assays have shown the exceeding richness of the deposit. Rich specimens of ore.

The ten-stamp mill has been recently refitted at a cost of several thousand dollars. The machinery consists of a boiler 75 h. p., engine 60 h. p., manufactured by G. I. Brown & Co. of Belleville, Cook's amalgamator, copper plates, six grinding and settling pans, two Frue vanners, one composite roasting furnace which may be used either for roasting sulphuret ores or the treatment of lead ores. The mill is 40 by 60 feet, with a lean-to, a boiler room, blacksmith shop, etc. The mill has only as yet been operated on samples. About 100 tons of various grades of ore have been treated. Machinery and buildings.

A force of 10 men was employed at the date of my inspection. It has varied nowever from 10 to 16 laborers The works both at the mine and mill were in a safe condition for the workmen and apparently were conducted with care and economy. Workmen.

Dr. H. N. Coutlee, whom I met at Sharbot Lake station, September 16th, informed me that he had done prospecting for gold on a property in Oso with good showing. Assay tests had given from 2 oz. down to a trace. Six men were employed, and the workings had reached a depth of 15 feet. The location is within 2 miles of Oso station, on the Kingston & Pembroke Railway. Prospecting in Oso township.

The McGown mine, which was described in last annual report by Dr. Coleman, was visited early in November. An open cut had been made at the base of the escarpment for the distance of 40 yards and about 5 feet in width, and varying from 2 to 5 feet in depth, exposing the vein for the entire length. Two hundred yards southeast from this working another opening had been made for some distance, showing the vein, and rich specimens of gold ore had been obtained, some of which were also rich in copper. Several fine specimens were shown to me, and it was stated that some recent assays made by Professor Heys of Toronto gave $30 per ton in gold and in copper 60 to 80 per cent. The vein matter is about 5 feet in width and has been traced by surface cuttings for the distance of three-quarters of a mile. *McGown Mine.*

Empress Mine.

Peter McKellar of Fort William informs me that the discovery and development of the McKellar gold lode near Jackfish bay, lake Superior, last summer promises to be one of the most valuable finds in the district. The vein is very large, 10 to 40 feet wide, and continuous for a long distance along its course. It has been opened out by cross cuts on three different half-mile square locations. The vein traverses the Huronian green schists near intrusive syenite, and consists of quartz associated with what appears to be talc schist. Both the quartz and schists are well mineralized with the auriferous sulphides, or iron, copper and lead. Free gold is present through the ore, and some of it is remarkably coarse. Although comparatively little work has been done on the vein, it has yielded hundreds of the finest gold specimens that have ever been produced in the district. Quartz veins in the locality were known to carry gold for many years; and now after this valuable discovery it will be a great field for the explorer, as the formation is of large extent in the vicinity. A local chartered company has been formed with capital stock of $100,000 in 20,000 shares of $5 each; $20,000 working capital has been raised. Work has been in progress since the beginning of December last on one of the locations, R569, under the direction of Mr. Wm. M. Caldwell, building roads, houses, etc. Mr. J. T. Horne is manager, and he has purchased a ten-stamp mill with copper plates and Frue concentrators of the latest improved style from Fraser & Chalmers of Chicago. The mill is in course of erection, and is expected to be in operation by the latter part of April next. Mining has been commenced on two shafts. One of the great advantages of this lode is that there will be no lack of ore for the mill, as it can be quarried from ledges 10 to 40 feet in width. Mr. McKellar says: "We ran 1,800 lb. of the common ore through the McKellar pulverizer at Fort William. The amalgam caught gave a gold button weighing 11 dwt. The tailings are rich, but on account of the frost I was unable to sample them. I panned and assayed some of the concentrates, and they gave $225 to the ton."

A company organized, and a mill in course of erection.

Permanency of gold-bearing veins in the Huronian rocks of western Algoma.

In reply to an inquiry made of Mr. McKellar regarding the depth of the ore deposits in the western districts of the Province, he writes: "In western Algoma within the last year there has been a great improvement in mining, with a considerable increase of ore of the gold milling capacity. The good results of the deeper mining is beginning to establish confidence in our gold mines. The Sultana mine is working below the 200-foot level, and is yielding much better results than when working on surface ores. The gold bricks from the weekly mill runs this winter are $2,000 to $3,000 each, much larger than formerly. Letters lately received from the Foley developments on the Weigand gold lode, Shoal lake, state that the shaft is down nearly 150 feet, and that the vein is larger and richer in free gold than it was at the surface. The richest gold ores taken out of the Huronian mine were taken from the lower workings at a depth of 100 feet, the samples sent to the Colonial and Indian Exhibition, London, 1886. These are some of the proofs that go to show that the gold lodes in the Huronian rocks, which are so extensively developed in the district, can be relied on for permanency here as well as in other great gold fields."

SILVER.

Mr. P. McKellar writes of recent date: "At Pays Plat river, Nipigon bay, about 25 to 30 miles west of the Empress gold mine on Jackfish bay, a silver discovery was made in the fall of 1895 by Mr. J. Weiden of Fort William which promises to be a valuable find. The vein is reported by reliable parties who have seen it to be enclosed in archæan rocks, to be 4 to 6 feet wide, and to continue for a long distance." Samples of the ore, Mr. McKellar states, would average two or three thousand ounces of silver to the ton. It resembles the bonanza ores of the Thunder Bay silver mines. The silver, both native and glance, with some galena and copper and iron pyrites, is disseminated through a veinstone which is largely fluor spar. In view of the character of the vein, the enclosing rock formation, and its proximity to the great lake Superior trough, it is considered significant. If it proves a valuable lode, as the showing indicates, it will no doubt encourage the working of many of the Thunder Bay silver mines to greater depths. A large number of locations have been surveyed and taken up on this vein, and much mining activity is expected when the navigation opens.

Discovery of silver at Pays Plat.

COPPER AND NICKEL.

At the date of my first visit of the present year to the Copper Cliff mine, May 16th, work was being vigorously carried on both in the mine and at the smelters under the continued general management of Mr. James McArthur, whose unremitting attention is given to every department of the work. The roast yards are managed by Messrs. Trist & McKinnon, the contractors for roasting and delivering the ore at the smelters. A couple of days were fully employed in looking over the whole of the operations, both underground and outside work.

Copper Cliff Mine.

Considerable work had been done in the mine since my last entry in the Inspector's Book. The new shaft had been sunk to a depth of 58 feet below the former measurements, making a total distance of 93 feet on the incline between the seventh and eighth levels. It had also been continued from the eighth to the ninth level, at the same incline, a distance of 72 feet. It had then been extended down below the ninth level 8 feet, making a total depth from the point where it intersects the old shaft at the third level on the incline of 77½° of 384 feet, and a total depth from surface on the incline of 657 feet. The shaft was neatly and securely timbered and fitted for use to the bottom; ore hoisting was being constantly done through it. The extensive stope referred to as the last item in the former report has been continued from the sixth to the seventh level, and the principal part of the ore removed between these levels. In the seventh level, 80 feet south from the new shaft, a vertical winze 6 by 8 feet had been sunk in the ore body to the eighth level. In the eighth level a drift had been run in south from the shaft 100 feet to the winze and a short distance beyond. At 75 feet from the shaft the ore body was reached. Thirty feet below the floor of the seventh level a stope was being opened in the winze. A stope was also worked in the

Extent of mining operations since the previous inspection.

eighth level drift at a point where the ore was intersected, 28 by 57 feet with a rise of 15 feet. In the ninth level a drift south from the shaft had been extended 100 feet to the ore deposit, and about 25 tons of ore had been taken out at this date. The mine was safely protected, and the work was being done systematically and apparently with care. From 60 to 70 men were employed in the mine and about 200 tons of ore were lifted per diem on the day and night shifts.

Outside work. The trestle railway track over which the ore, with other supplies of material for the furnaces is hauled, had undergone material improvement. For the distance of 800 feet it had been supplied with additional substantial plumb and buttress posts; 800 new ties had been put on with new flooring. At other places where required new timbers had been put in place, making the whole of the elevated track strong and safe. While examining the trestle work in company with the manager a train of nine loaded cars passed over it, the net weight of ore being not less than 160 tons, while the gross weight of cars, locomotive, water, etc., would be fully 130 tons, making a total strain of 290 tons, and although the train was moving at a fair rate of of speed there was but a slight tremor and no indications of weakness. A simple device is adopted as a gnal against accident to persons riding on the top of cars while passing der bridges or overhead staging. Short pieces of cord are suspended across track at some distance from the place of danger, which may be felt by the party exposed. Casks filled with water are placed along the elevated track as a protection against fire.

Water supply. A pump of 8-inch discharge and capacity of 750 gallons per minute supplies all the water for the furnaces and smelting works, by lifting it a distance of 1,000 feet with elevation of 50 feet to a large reservoir which feeds every department of the smelters. The water passes through a fine screen to exclude all impurities before entering the pump. Under the same neat covering an auxiliary pump of 300 gallons per minute is kept in readiness for use in case of tempory failure of working pump, or when the same requires repairs. Ample provision is made to protect the buildings against fire by a plentiful supply of hose and several hydrants attached to the large water pipe.

The smelters. Both smelters, which were in good condition, were kept constantly running (except in case of temporary stoppage for repairs) and were treating the usual quantity of ore. The slag runs out in a continuous stream through the spout and is emptied into the large water tank outside the building; thence it is lifted in its granulated state by chain elevators and dumped into tram cars and run over enclosed elevated tracks to the huge waste heaps. Since my former report another chain elevator plant has been added, and it is estimated that at least 200,000 tons of slag have accumulated.

Machinery. All the machinery including the two boilers and two engines at the smelting works, and the same number at the mine, as well as the compressor, was in excellent running order.

Fuel. A supply of 10,000 cords of wood was on hand; a couple of thousand tons of coke and a quantity of coal.

The roast yard was under the direction of Messrs. Trist & McKinnon, the contractors, who received the ore on the cars, place it on the roast beds, calcine it, and deliver it at the smelters. Time is allowed for the roast heaps to cool befcre being broken up for removal to the smelters. About 20,000 tons of roasted ore and 6,000 tons in the raw state were on hand. The work on the roast yard was apparently being done with care. Roasting the ore.

The entire force employed by the Company and at the roast yards would exceed 300 laborers. The sanitary arrangements were carefully looked after, and the public school under two efficient teachers was well sustained. Religious services are conducted every Sabbath, and a good Sabbath-school maintained. Employés

On October 30th and November 1st I again made a careful inspection of the Copper Cliff mine and was pleased to find the work in good shape. At this date the principal part of the work in the mine was being done in the eight and ninth levels. In the eight level there had been an advance in length 43 feet, making the total length of stope 100 feet. The width had been extended 28 feet, making total width 56 feet, with an additional rise of 45 feet, or a total elevation at the highest point of about 60 feet. In the ninth level nearly all was new work excepting the drift. The length of stope was 85 feet, width 31 feet, and elevation about 50 feet. Partitions and doors had been placed in the third, fourth, fifth, sixth and seventh levels, walling off the irregular currents of air and securing better ventilation in the eight and ninth levels, especially in the former. A winze was required to be put through from the eighth to the ninth level to insure good air. The captain said that this would be done at an early date. A 4-inch air pipe extends from the third down to the ninth level, through which the compressed air passes, supplying power for the drills and pumps and aiding in ventilation. All approaches to the shaft were protected by railing. An excellent system of signalling has been adopted for the safety of the men and mine, and the printed rules signed by the general manager and captain of the mine have been posted up in conspicuous places. The following notice is affixed thereto : Second inspection. Progress of workings in the mine Signalling.

"Any one found violating this law will be discharged from the Company's employ."

Capt. Henry Davis has the direction of the work in this as well as in the Stobie mine ; Mr. John Greer is the master mechanic. Both are required to make daily reports of any defects, repairs, improvements or other needful matters, the entry of which is recorded in a book kept for this purpose. The same applies to the trimming of walls, etc. in the mine. Officers of the mine.

The rock house was in good shape. Two new cables for lifting ore had just been supplied in place of old ones and two additional automatic steam whistle signals to give warning of skip dumps were being put up. The gongs were also retained. Rock house.

The boilers were properly supplied with water and steam guages and safety valves, which were kept in good order. The engines, compressed drums and all machinery were working smoothly. The rock breaker, sorting tables, and Machinery.

screens were examined, as well as the machine shop, which latter contains a small engine, two lathes 12 in. each, planer 10 by 30 in., drill press, bolt cutter 1 to $1\frac{1}{2}$ in., circular saws etc. A long coil of hose was kept in readiness in case of fire. The changing and drying room, 18 by 30 feet, was supplied with all necessary conveniences for the men.

Roast yard and smelters.

I passed over the roast yard a couple of times and the work was being done with apparent care. The smelters were running with their usual capacity under the charge of Mr. Thomas Kilpatrick, to whom is remitted the management of this department.

The laboratory.

The laboratory was a scene of active and skilled industry, with Mr. David H. Brown, a gentleman of large practical experience as chemist, and Mr. Shuler as assayer. The following is an account, courteously furnished me by Mr. Brown, of the daily routine of laboratory work so far as it relates to the sampling and determination of copper-nickel ores and their products :

The routine of the laboratory.

"The laboratory of the Canadian Copper Company is so arranged and equipped that the metallic contents of any ore or furnace product can be determined in the minimum of time and with the maximum of accuracy. It is of the utmost importance that the sample analyzed should be what it purports to be, that is, a mixture representing an equal weight of substance from every unit measure of the product sampled. That is to say, a sample of matte should contain an equal number of particles from every pot of matte thereby represented, and a sample of ore used in one day should contain an equal weight of ore from every barrow load of ore in that day's supply. To produce this result, the greatest care is necessary, since an accurate analysis of an inaccurate or imperfect sample is as useless for all commercial purposes as an inaccurate analysis of a correct sample.

"As the ore is received from the roast heaps it is dumped into bins on the furnace floor, and taken to the furnace in hand-barrows. The sampling is effected by taking a small shovelful of ore for each barrow load in a charge, the shovelfuls being thrown into a box which is emptied every twenty-four hours. The ore sample is taken every day to the sample room and the entire lot passed through a small Gates crusher to reduce it to uniform small size. This ore is now spread out, thoroughly mixed and quartered, the quarter sample again crushed and mixed, and a bottle full of the remainder set aside as an average of that day's ore supply.

"At the end of the week a list is made from the furnace book of the amount of ore used at the furnace each day, and from each daily sample an amount of ore is accurately weighed in exact proportion to the number of tons of ore used on that day. Seven such weighed samples representing a week's work are mixed, passed through a fine sieve, and a small amount of the mixture sent to the laboratory for analysis.

"The sampling of matte is made when the material is in a molten condition, for owing to the segregation of metals in the matte an accurate sample can not be obtained by breaking from the outside or centre of the pot. The tapper plunges to the bottom of each matte pot, when filled

with melted matte, a smooth iron bar about one inch in diameter. This bar on being immediately withdrawn brings with it a thin skin or coating of matte, which on cooling falls into the bucket in which the bar is kept. A sample of slag is taken at the same time by catching a small ladleful as it flows over the slag spout. These daily matte and slag samples are treated as the ore samples are in order to obtain a thorough average of each lot, or week's product.

"The laboratory samples of furnace products, as well as of ores from the mines, are all kept in a large cupboard for at least a year, in order that any question which might arise in that time may be set at rest by a second analysis of the samples in question.

"Duplicate determinations are made for copper and nickel in each week's product of ore, slag and matte, and in the case of mattes a further analysis is made of each consecutive hundred tons produced, and also of each shipment as it leaves the yard. In this way the matte has three samplings before it goes to the purchaser.

"At regular intervals complete analyses are made of the mattes to determine the total contents.

"The equipment of the laboratory differs in no way from any modern analytical workshop. Electricity is used to determine the amount of copper and nickel present, while the precious metals are determined by fire assay. Three very accurate Becker balances are used in final weighing.

"A library containing all the books, pamphlets and patents that appear on nickel or copper-nickel is a part of the laboratory equipment, and is of valuable service in keeping this branch of work abreast of the times."

Economic improvements.

The general manager has projected a circular railway track, extending a short distance beyond the mine and forming a curvature of 700 feet across from side to side. The roadbed was being made by filling in granulated slag of sufficient width to store an almost unlimited quantity of wood alongside the track. By this happy expedient the wood can be unloaded from and reloaded on the cars without hauling by teams, while the train, by taking the short circuit, reverses its course. The old powder house, which was standing near the centre of the circle described by the track, has been superseded by a substantial fireproof structure, placed some distance outside the track. In the centre of the circle a large reservoir of pure water has been secured and covered with a neat frost-proof building. To the reservoir may be attached a hydrant and hose in case of fire in any of the buildings. The carpenter shop standing near the track has been sufficiently enlarged to render it convenient as a locomotive shop, into which any disabled locomotives or cars may now be run for repairs. All the ordinary appliances for this purpose are attached. These new departures in improvement indicate the economic methods adopted in the management of the company's works.

Further progress at the mine.

A recent communication from the manager states that the winze has been put through from the eighth to the ninth level, and that good ventilation is now secured in the ninth level; also that additional stoping had been done in both the eighth and ninth levels since my last visit. The mine was

closed down late in December, except for development work and shaft sinking. The captain says: "We have our shaft well on the way down 30 feet, and we are getting ready for the pentice. We have also started a winze at the ninth level for the purpose of ventilation and to give a better chance to open up the stope at the tenth level."

Stobie Mine.

On May 17th a visit of inspection was made at the Stobie mine, accompanied by Capt. Davis, who has charge of this mine as well as of the Copper Cliff. I had the pleasure of meeting Messrs. H. P. McIntosh, of Cleveland, secretary-treasurer of the company, and George F. Allen, of Akron, Ohio, stockholder, who, accompanied by the manager, were here looking over the property. A total force of 60 laborers was employed in the open pit and on outside work. John Harris and Wm. Skews were foremen for day and night shifts in pit work.

State of the works at first inspection.

The water had been removed from the pit, and the skip track extended down to the bottom of the workings, a depth of 85 feet from surface. The underhand stope, 46 by 54 feet, had been extended down 15 feet since the former measurement; three drills were here used, and work was being done on the sides of the pit, taking out the ore to the depth of the skip track. From the open pit at the west end of the tunnel (described in my former report) another drift 8 by 9 feet had been run in west and advanced 43 feet. Two drills were being used at this place of working. As shown by the register, 611 skips of ore of over a ton each had been taken out during the previous week, and 66 skips of barren rock. The rock house had been securely staged, and due care was taken not to overload it. The ore is crushed previous to its shipment to the roast beds at Copper Cliff. The two large boilers were supplied with water gauges and safety valves, kept in good order. About 80 lb. of steam was carried, with blow off at 88 to 90 lb. Twelve cords of soft wood were being consumed in 24 hours. A large quantity of wood is brought in and corded up at the railway track, and thence it is conveyed by daily train over to Copper Cliff.

Second inspection.

This mine was again inspected October 31st. No changes since my previous visit had been made in the mine, engineers or foremen. Seventy five laborers were employed 10 hours per day, and about 180 tons of ore taken out daily and shipped to the roast yards. The open pit had been sunk to an additional depth of 26 feet, making total depth from surface 111 feet; additional length of 70 feet, making total length 116 feet; and additional width of 7 feet, making total width 61 feet. The new drift in the other open pit which was being worked at the date of my former inspection had been advanced 7 feet, making total length 50 feet. Work was suspended at this point.

Progress noted.

State of the mine and machinery.

The main workings in the pit were considered safe, excepting a point of rock jutting out near the skip track, which I directed should be removed. The timbers over the skip track supporting the roadway above were sprung and showed weakness, and new additional timbers were being put in. The machinery was kept in good condition. The boilers were neatly cared for, being oiled weekly and cleaned out regularly every two weeks. I examined

all appliances for safe running, water gauges, dials, blow-off cocks, etc., and found them in place and working well. The rock house was standing firmly, and was not too heavily weighted with ore. I called the attention of the master mechanic to the necessity of placing a railing along the runway to the sorting tables. All barren rock sorted in the mine is dumped on waste pile from the skip track before entering the rock house.

Work at the Stobie mine was suspended last of December, except fitting up for extensive operations in the spring. The skip track will then be changed, a shaft sunk from the bottom of the open pit, and levels will be run in through which the ore will be taken out. The pit is as deep as open work should be conducted. The powder house is located 200 yards from the mine, (Winter work.)

The changing room required lockers for the safe keeping of the clothes of the workmen while in the mine. This building was also used for thawing the explosives. I directed that this should be done in another place prepared for the purpose. (Drying room.)

Two or three years ago, at a point one mile west of the Stobie mine, three test pits were sunk to the respective depths of 15, 18 and 20 feet on which work may be resumed in the future. The place is designated as the Little Stobie. (*The Little Stobie.*)

No work has been done at the Worthington mine since the middle of September, 1894. A sufficient quantity of ore however was on hand when the mine shut down to keep the smelter at the Blezard running until July, 1895. When at the smelter in May some repairs were being made which would occupy a couple of days. The daily run was from 90 to 100 tons of ore, and the matte was shipped as fast as made. Capt. McBride had charge with a total force of 52 men. Mr. Cameron was then absent in British Columbia. All the ore had been roasted, and a supply of wood and other material was on hand to complete the smelting. The furnaces, wells and all connected with the smelters were in good condition, excepting the small part undergoing repairs. (*Worthington Mine.*)

The Cameron mine, distant about two miles from the Blezard mine, was being worked with a force of 12 men, under the direction of Captain R. McBride at the date of my visit, October 31st. Mr. Ian Cameron had the general management. A vertical shaft 6 by $9\frac{1}{2}$ feet inside of timbers had been sunk 40 feet, and at a dip of 50° n.e. to a greater depth of 10 feet, making the total depth 50 feet. The machinery used was a boiler of 50 h p., a No. 3 Canton pump, steam drill, horse derrick and buckets. A boarding house 27 by 46 feet, with cooking apartment 12 by 27 feet and lodging rooms above, together with stabling and outbuildings, were in process of construction. The mine presented an encouraging outlook. From a recent communication I learn that the shaft is down 65 feet, with 66 feet of drift. "The show of ore is fairly good." (*Cameron Mine.*) (Development work.)

The Vivian, Travers and Blezard mines have been closed down throughout the year. It is probable however that they will be operated again at an early date. (Mines and works closed down)

Properties in Levack township.

Messrs. James Stobie and Robert J. Tough are owners of three properties in the township of Levack, consisting of parts of lots 6 and 7 in the second concession and of 2 in the fourth, the nearest being about four miles from Onaping station on the C. P. R. Four years ago twenty miners were employed to open up lot 7 at a number of points, and a report made by Mr. A. Merry of the H. H. Vivian Company's works stated that the workings and face of the hill showed solid masses of pyrrhotite, with comparatively small quantities of copper pyrite. The average of a number of assays of average samples taken and made by Mr. Merry gave 3.74 per cent. of nickel in the pyrrhotite. Pits sunk from 10 to 15 feet were in solid ore. The deposit on lot 6 is on the same range, and workings have been done upon it which Mr. Merry states show large masses of solid pyrrohtite to depths of 10 to 14 feet. The average of a number of assays made by him of ore from this location gave 3.96 per cent. nickel. On lot 2 in the fourth concession deep trenches and pits have exposed large deposits of pyrrohtite over an extended area. "Quite sufficient work has been done," Mr. Merry reports, "to warrant one in inferring that we have here a deposit equal to if not greater than any mine now being worked by any company in Sudbury." Average assays of ores from the several properties gave 3.86 per cent. of nickel and 0.81 per cent. of copper. The proportion of copper to nickel in the ores appears less than in the average of Canadian Copper Co. ores ; and for this reason Mr. Merry thinks it is possible to concentrate matte to a higher grade than they are able to do at that company's works.

Wilcox Copper Mine.

Copper was discovered in 1893 on lots 18, 19, 20, 21 and 22 in the fourth concession of the township of Cowper, Parry Sound district, near the shore of the Georgian bay and 12 miles south of the town of Parry Sound. Half of each lot is held under lease by Messrs. Henry Harris and Thomas Wilcox, the discoverers, who have expended about $500 in developing the deposits. Four test pits from 5 to 10 feet deep have been sunk along the vein. Assays from all the openings have shown the ore to run as high as 10 per cent. in copper and from 2 to 4 oz. of silver per ton, with traces of gold. Negotiations for sale to a New York syndicate are being made, and in the event of not selling the present owners intend to work the property on a fair scale at the opening of spring.

IRON.

Ore deposits in South Sherbrooke

Mr. A. B. Rudd of Perth has purchased the mineral rights of lot 9 in the ninth concession and the east half of lot 8 in the ninth concession of South Sherbrooke, county of Lanark. The outcropping of ore continues across lot 9 and on lot 8, showing a width of nearly the distance of the two lots. The following is a copy of the analysis of several samples of ore taken from the test openings :

Ferrous oxide	28.29
Ferric oxide	66.23
Alumina	.180
Sulph. anhydride	.168
Magnesia	.38
Silica	2.79
Total iron	68.43
Sulphur	.67
Manganese	.26

This property is six miles east of Sharbot Lake station on K. & P. Railway. Mr. Rudd has also purchased the mineral rights and opened the vein on lot 15 in the fifth concession of Oso in the county of Frontenac. The work consists of stripping the vein for a width of 15 feet, and for some distance exposing a large body of magnetic ore. The analysis has shown it to be of good grade and excellent quality. and Oso.

Of recent date 600 acres have been purchased by the Calabogie Mining Company with a view to early future operations. The Company's capital stock is $100,000, with paid up stock of $80,000. The head office is at Perth. President, J. G. Campbell; vice-president, Hon. P. McLaren; secretary, Mr. J. A. Allan; all of Perth. The principal part of the stock is held by Canadian capitalists. The property consists of lot 16 in the eleventh concession, the east ½ of 16 in the ninth, the east ½ of 16 in the eighth, and lot 14 in the seventh, all in the township of Bagot, county of Renfrew. Two hundred acres are held in fee simple, and four hundred acres by mineral rights. Some ten years ago considerable mining had been done on several of these lots. A shaft 7 by 8 feet had been put down at an angle of 40° under the escarpment to the depth of 300 feet, following the ore to the entire depth. A large quantity of magnetic ore was taken out of the shaft and stopes, averaging 60 per cent. Recently 1,000 tons were shipped to Radnor Forges, north of Three Rivers, Que., to mix with bog ores, which gave satisfactory results as to quality. Two vessel loads of the ore were previously shipped to furnaces in Ohio, the report from which was equally encouraging. A hundred and fifty feet east of the first shaft another shaft was sunk on the level, at the same angle as the former; at 20 feet vertical depth the ore body was reached and the shaft was continued in the ore only a few feet, when work was discontinued by the company and the property leased to the Kingston and Pembroke Mining Company under royalty. The latter company continued this second shaft to a depth of 65 feet, a drift was run in east 65 feet and stopes made from which were taken 3,000 tons of ore which was shipped to the Ohio furnaces. Considerable ore was also obtained from surface workings. In 1888 the property reverted to the former company, who continued work by sinking a shaft on the west half of lot 16 in the ninth concession, with excellent showing of ore. On the east half of 16 in the ninth concession there had been workings by Mr. Coe of Madoc, and as a result about 1,200 tons of ore were lifted and are now lying on the dump. Also on the south half of lot 15 in the eighth concession a vertical shaft 8 by 8 feet had been sunk 45 feet, following the ore to the bottom.

Calabogie Mining Company

Working the mines.

The present company have purchased from the municipality the intervening mining right under all roadways which would interfere with the working of the properties, but they are not to obstruct the roadways. A siding from the railway can easily be laid in to the workings and the ore when lifted from the mine can be dumped on the car.

The mineral rights of the north half of lot 16 in the tenth concession have been purchased by the Hon. P. McLaren, Judge Elliott of London, and Messrs. J. G. Campbell and Wm. Hicks of Perth. A test vertical shaft 6 by

Other properties in Bagot, Oso and Olden.

7 feet has recently been sunk to the depth of 20 feet on this lot, from which a few tons of loose ore have been obtained. Also 500 feet northeast of this shaft another test shaft has been put down 22 feet. For a few feet the sinking passed through clay, then a thin layer of shale, and at 16 feet depth hornblende. At the bottom the ore body was reached. The inflow of water interfered with further working without suitable machinery being applied.

Mr. Campbell has procured the mineral rights of lot 13 in the fourth concession of Oso and the north half of lot 11 in the sixth concession, as well as lots 8 and 9 in the fifth concession of Olden, all having surface outcroppings of ore and strong magnetic attraction. Development work will be done on each in the opening spring. It was anticipated by the owners of the foregoing properties that a part of the supplies of ore to be used in the Hamilton smelter, which has recently been blown in, might be obtained from these extensive ore deposits. Correspondence to this end was then being conducted. There have been erected two boarding houses, engine house, blacksmith shop, etc. The plant was purchased in Michigan and consists of a boiler 25 h. p., engine 20 h. p., double hoist, two skips carrying a ton each, a Cameron pump and steam drills, all ready for operation.

Mattawin iron ore deposits.

The Hammond iron deposits on the Mattawin river were examined by American experts for the Bethlehem Iron Company, Pa., last fall with a view to purchase. Mr. P. McKellar of Fort William writes that he had been recently informed by Mr. Hammond that an agreement of purchase was made, and that the first payment which fell due a few days ago was promptly met.

Headstrom Iron Co.

The Headstrom Iron Co. had a number of miners employed for a couple of months back, testing the Animikie iron beds between Thunder bay and Loon lake with a view to work and ship ore to the Hamilton smelter. Work at present is suspended.

BARYTES.

McKellar island lode, in lake Superior.

The McKellar island barytes lode has been purchased by Mr. W. P. Lardner of Duluth and his associates. The last payment was made and the stock transferred on the first of December. These parties have been testing the manufacturing qualities of the ore for some time back with favorable results. It is yet undecided as to where the manufacturing will be carried on, whether at Duluth, Chicago, or on the island.

MICA.

Canton Mine.

My inspection of the amber mica producing mine situated on lot 1 in the fourth concession of South Burgess, county of Leeds, comprising 100 acres, was made on September 14th. The mineral rights are held by Messrs. Webster & Co., American capitalists. Mr. J. E. Chown of Sydenham is the general manager, and Capt. Samuel Cordick, an old miner, has charge of the work at the mine. A force of 35 men was employed in the mine and in sorting ore. This property has been worked in previous years, but

it was not until the 9th of September, 1894, that the present owners began operations, since which time work has been continued. The workings may be described as follows: No. 1 open pit, 12 by 30 feet at the surface, has been sunk to a depth of 100 feet, with a slight incline south. Stoping was begun in the open cut at 30 feet from surface, extended southeast 50 feet, and then downward to the bottom of the pit. The ore was removed between the walls to a width of 12 feet, leaving an opening 12 by 50 feet and a rise of 70 feet. The ladderway with proper rests and convenient incline is walled off from the open cut down to near the bottom. No. 2 pit, east of No. 1, has been opened, leaving a collar of 12 feet between them as support. Stoping in the vein has been extended 60 by 12 feet, and is at greatest depth 40 feet, at the same incline as pit No. 1. Work was progressing in both pits. The stope in No. 1 had extended under part of pit No. 2 and the uprise will be made to it, pillars being left to support the walls, which are also of solid formation. A hole was being drilled through from pit No. 2 to No. 1, to reach the pump which is in the lower pit for the purpose of drainage. The rock is hoisted in buckets by the use of two derricks operated by steam, the larger one serving the purpose of hoisting the chief portion of rock from both pits. The other is used for hoisting at the southeast end of pit No. 2 for work near the surface. Drilling is done by steam. The machinery consists of a boiler of 20 h. p., an Ingerso l hoist, and a Cameron pump used for lifting water out of the mine. Description of the workings.

The buildings are a boarding house 18 by 36 feet, a sleeping camp 20 by 30, an office 14 by 24, a mica house 24 by 24, and blacksmith shop, stabling, etc. Buildings.

The mica when taken out from the mine goes to the mica house where it is cobbed, put into barrels and then hauled a distance of 12 miles over an excellent road to the mica house in the town of Perth. Here it is carefully culled and packed in barrels and shipped via C. P. R. to the American market. The work in the mine was being safely conducted, but no railing or guard was placed around the open pit on the surface, which I directed should be done excepting at places required to be kept open for work. The machinery was kept in good order and working smoothly. Preparing and shipping the mineral.

In a recent communication from the manager he says that the mine is closed down at present owing to some defect in the boiler, which has been sent to Montreal for repairs.

A white mica mine at Pike lake, on the south half of lot 16 and the south half of lot 17 in the ninth concession of North Burgess, comprises 200 acres. The former parcel is held by lease, and the latter by purchase of mineral rights. The property is owned by Messrs. T. J. Watters and M. A. Allen of Ottawa. The general manager is Mr. D. G. MacMartin of Stanleyville, and the work at the mine is under the direction of Captain T. J. Smith. The mine had not been extensively worked during the former part of the year, and at the date of my inspection, September 14th, seven men were employed in pumping the water out of the deepest workings with a view to a general renovation, as its present condition is unsatisfactory and by no means safe for *Pike Lake Mine.* Condition of the mine.

the workmen. Mining previously had been done at intervals, and about half a ton of sorted white mica was on hand, with a large quantity in the rough lying on the dump. An open cut, 15 by 35 feet, to the depth of 25 feet had been made. Immediately by the side of this pit a vertical shaft of irregular shape had been sunk to the depth of 80 feet from the surface. At the bottom of the shaft drifting and stoping had been done to a limited extent. No accurate measurements could be made in the deepest working, on account of water and the very unsafe condition of the walls. I directed that no mining of ore should be done until the walls were trimmed, the shaft substantially cribbed, and such parts of the workings as were exposed by overhanging walls should be well supported by stulls or timbers.

The workings.

Machinery.

The machinery consisted of a boiler, 30 h. p., a Copeland & Bacon double cylinder hoist, a Worthington pump for lifting water from the mine, derrick and steel buckets, and blacksmith shop outfit. The machinery was in good condition.

Downey Mine.

Development work.

Mr. A. B. Rudd of Perth has acquired the mineral rights on the southwest quarter of lot 7 in the first concession of South Burgess, on which some development work had been done previous to the purchase. A pit has been opened under the escarpment 14 feet in width and extended 25 feet, exposing the vein for the full width of the opening. A considerable quantity of merchantable amber mica had been obtained and sold. Recently a few tons have been sorted from the dump and disposed of. The property is two miles from the Canton mine and 14 from Perth. The associated rock with the mica crystals is limestone.

Grant Mine.

The Grant mine is on lot 8 in the tenth concession of Loughborough, county of Frontenac, six miles north of the village of Sydenham. Six men were employed in September under the management of Mr. J. E. Chown. The property is owned by Messrs. Webster & Co. The small quantity of mica mined at this date had been hauled to Sydenham and sorted for market. Several open cuttings had been made, the deepest 20 feet. A derrick with horsepower was in use for hoisting rock. In a late letter received from the manager he says: "Since meeting you we have made five openings, and all excepting one of the veins pinched out with hard rock at a depth of from 10 to 20 feet. The opening we are now operating with a force of four men and a horsepower derrick is on the north part of the lot. The shaft is nearly perpendicular and is 35 feet deep. The vein runs northwest by southeast, dipping slightly to the southwest. The associated vein matter is lime and pyroxene. The output at present is about 1,000 lb. per week. We are doing some prospect work on the old Smith & Lacey mine, but as yet have nothing special to report."

Baby Mine.

Baby mine is on the northwest half of lot 13 in the fifth concession of North Burgess, 100 acres, and is owned by Mr. T. J. Watters of Ottawa. For three months previous to my inspection (Sept. 13th) it had been worked with a force of 8 men and from two to four tons of crystals had been taken out monthly, which produced eight tons of merchantable amber mica. The

workings consist of an open cutting 70 by 20 feet, with graduating depth from 20 to 85 feet. At the bottom a stope had been made 18 by 35 feet, with a rise of 18 feet. The walls were firm, although the formation varied, and a considerable quantity of waste rock had to be lifted. The inflow of water retarded to some extent the work of mining. Mr. MacMartin has the general management, while Captain T. J. Smith has charge of the work at the mine. The machinery was in good condition and consists of a boiler of 15 h. p., an engine, single cylinder hoist, a No. 3 Ingersoll steam drill, and a pump for boiler. Hoisting is done in buckets. A tent blacksmith shop and mica house comprise the buildings. *Extent of workings.*

The MacMartin mine property is composed of lot 1 in the sixth concession of North Burgess, 200 acres, and had been worked extensively for phosphate in former years. Mr. MacMartin was engaged when I was at that place, September 13th, in sorting for market a small stock of amber mica which had been recently mined. In several places there was an excellent showing of mica, easy of access. The place is held by lease. *MacMartin Mine.*

The Harris mine is on lot 18 in the second concession of the township of Fergusson, 10 miles north of Parry Sound. It was discovered in March, 1894, and has been worked since at intervals by from two to four men. Fifty acres have been leased by Messrs. T. T. Freeman, of Salamanca, T. C. Freuse, of Olean, both of the State of New York, and A. Short, of North East, Penn. These gentlemen have formed a company known as the Georgian Bay Mining Company, with a capital stock of $60,000. The mine has been operated by Mr. Henry Harris, who resides within 1½ miles from the workings. Work at the mine had ceased a short time previous to my visit, October 5th. An open cut had been made 30 feet in length, 7 feet in width, and at the greatest depth 25 feet. The vein was about 3 feet in width and the mica white, though somewhat mottled. Large crystals had been obtained, some of 500 lb. weight, and although many of them were twisted yet 20 per cent. of the product was merchantable, some of which had cut as large as 8 by 10 inches. Between two and three tons had been marketed, the return from which had covered the entire expense of mining. At this date over $500 had been expended on opening the mine and handling the product. Another test opening had been made at a quarter of a mile distant on Crown lot No. 17, in concession 2. A few shots had been put in exposing a quantity of pure white mica, although the crystals were irregular or twisted. It is probable that as greater depth is attained the crystals may be found free from this serious defect. *Harris Mine.*

Oak Ridge mine is situated 1½ miles east of Waubamik, on lot 8 in the twelfth concession of the township of McDougall, Parry Sound district, and was discovered in July last by Malcolm McNeil. The lot was owned by Mr. John Campbell, who transferred it recently to Frederick P. Laushner. The present owner has done development work in stripping the vein for some distance, which shows a width of 7 feet and has outcroppings for 500 feet. The mica is white, but shows the defect peculiar to this imme- *Oak Ridge Mine.*

diate locality of being spotted. The owner intends to determine the value of the property by active development.

Valentine Mine.

Valentine mine is on lot 12 in the tenth concession of McDougall. The lot is owned by Mr. John Land, of Waubamik, but the mineral right has been obtained by the Valentine Mining Company. Mr. James Mitchell, a part owner, with a force of from 3 to 5 laborers, has conducted development work from June up to the latter part of October. An open cut has been made 14 by 18 feet to the depth of 15 feet. The vein has shown a width of 12 feet. A small boiler and engine for hoist and running a drill has been used. The output of merchantable mica has not been large. The expenditure up to the date of my visit, November 5th, has been about $1,000. The mica is of fair quality.

McNiel Mine.

McNeil mine is on lot 11 in the first concession of the township of Fergusson. Mr. McNeil, who owns and resides on the lot, has transferred a two-thirds interest of mineral rights to Messrs. John Bartleff and Louis St. George, and retains the remaining one-third. A few test openings have been made along the outcropping of the mineral and some excellent specimens of white mica have been taken out and marketed. Judging from the surface indications, as well as from the work done, the property may prove very valuable in its yield of a good quantity of mica, though not entirely free from the mottled appearance. It is but a short distance from the Waubamik post office. It was lying idle at the date of my visit, November 5th.

Burpee Mine.

A small amount of prospecting has been done on a lot in the township of Burpee by Mr. Henry Harris, the discoverer, and some excellent specimens of pure white mica obtained and marketed in Toronto at $2 per lb. The property is seven miles west of Waubamik (which means White Beaver) and 30 miles from Parry Sound. The vein has been stripped for a distance of 40 feet and to a few feet in depth. Three men were employed, and if on further development the showing continued satisfactory the force would be increased and work conducted on an extensive scale.

GYPSUM.

Paris Mine.

The Paris gypsum mine was visited July 24th, when both mine and mill were lying idle. Work had been vigorously carried on during the earlier part of the season, and it was expected would soon be recommenced. Some refitting had been done at the mill.

Description of the workings, and condition of the mine.

On November 27th I again visited the mine and found it in a fairly safe condition. The main drift had been extended 200 feet south from the surface entrance near the river, and a large quantity of gypsum rock removed. Work was being done at a point 65 feet from the extremity of the drift, by blasting out the breast of the layer of plaster to a width of about 8 feet and walling up the old workings with the waste rock. When enough rock was not at hand to build sufficient pillars, strong stulls were put in for support to make the place of working safe. During the time the mine was not

worked there had been an extensive cleavage of rock from overhead in the old workings caused by the weight above, rendering these parts of the mine unsafe. The formation above the layer of plaster, from 3 to 4 feet in thickness, is not solid. Above the plaster is a layer of slate from 2 to 3 feet in thickness; above this layer is another of plaster of about 18 inches in thickness, above which is conglomerate and principally clay as it nears the surface, which in perpendicular elevation from the place of working is about 85 feet. The three workmen employed were taking out from 3 to 4 tons of plaster daily; this was hauled a distance of 1½ miles to the mill in the town. The plaster is mined by contract. The air was bad in the extremity of the drift, and I advised placing a large heated stove at the mouth of the drift to be fed with air through a pipe from the back end, which would cause a circulatory motion of the atmosphere and secure proper ventilation for the men while working. At this date the mill was in vigorous operation, manufacturing the different products to which gypsum is applied. A large demand has grown up for the output of the company's works, especially the product alabastine, which was being put up in 5 lb. cans for shipment. It is used for decorating walls in a great variety of shades. Instructions for intermixing tints are given as follows: "By intermixing our tints the painter can make any shade that can be made with colors and white, and can easily make the same again by measure. The surface produced by alabastine is richer and has more lustre than any of the so-called water colors or paints; while it is what is called a dead surface, it has a rich crystal-like lustre. The base of the material from which it is made is treated by a patent process that polishes and preserves its atomic crystals, which under a powerful microscope are transparent, though in a body they are very opaque. The tints are made by automatic machinery, and are permanent and uniform." I have examined some of the walls treated by this finish, which present exquisite beauty. The alabastine also, it is claimed, serves as a disinfectant, a quality which cannot be secured in wall papers, especially when old. I was told by Mr. R. E. Hare, foreman of the mill, that shipments in cans to the extent of 15 tons of alabastine had been made during the year to Australia, where this enterprising company has an agent constantly employed. Large quantities of plaster have been ground during the year for land fertilizing, and a very increased quantity prepared and put up in barrels with other admixtures as potato bug finish. The demand for it in the calcined state is large. Other supplies of the rock besides that mined at Paris are brought from the beds in the vicinity of Cayuga. There is prepared at the mill for commercial purposes land plaster, calcined plaster, paristone wall plaster, potato bug finish, alabastine, tellstone (a cheaper product than alabastine), and paint for oil barrels. Mr. T. W. Wheeler of Paris is the manager of the company.

The mill at Paris.

Alabastine.

Land plaster and other products.

On lot 16 in the first concession of the township of Brantford, one mile east of Paris and on the north side of the Grand river, a new opening for plaster was being made. The property, comprising 133 acres, is owned by Mr. John Torrence of Paris, and occupied by Mr Wm. Hynes as tenant,

Torrence Mine.

who is an old miner, who, in company with James Wright, another miner, had driven in a shaft from the brink of the river north 45 feet at the date of my visit, November 27th. Limited prospecting had been done at the place of opening some fifty years ago, but the work was abandoned and nothing further done until the present year. Along the drift some excellent specimens of plaster were obtained, intermingled with slate; the extremity of the drift was in clay. It was the intention, I was told, to advance the work much farther in the same line, with the expectation of intercepting the regular layer of plaster.

Garland Mine.

I went through the Garland mine July 18th, when two men were employed in refitting some parts of the drift which had become seriously dilapidated in places. Mining work had been suspended for three weeks. At the bottom of the incline drift, 80 yards from the surface entrance, a new drift had been run in east for the distance of 100 feet to the continuous layer of plaster. Patches of plaster had been met as the work progressed. It was intended to extend this drift in the layer of plaster to determine its extent. In the old regions of the mine the plaster had been worked out with the exception of a large pillar left as support. I directed that the old drift from the entrance to the point where the new drift began should be thoroughly refitted with new and substantial supports, as many of the parts were badly decayed, as well as some of the flagging overhead. About 250 tons of plaster had been taken out during the present year and hauled to the mill in Caledonia.

Workings and improvements.

Second inspection.

On November 28th, when I again visited the mine, the new drift had been extended only a few feet beyond the former measurement, making the total distance from the old drift 108 feet. Work other than fitting up the mine had been suspended in the latter part of the summer. The new drift I found in excellent condition; the old drift had been supplied with new timbers in many places, and for the time being was considered safe. Nothing had been done in the old workings, which were in an unsafe state for work. The large pillar of ore left for support will not be removed at present, as it protects the part of the mine where the air shaft has been put down for ventilation. Mr. Wilkinson, who has charge of the mine and who resides on the place, informed me that work would be commenced immediately in taking out plaster, which he does by contract and hauls to Caledonia at $1.30 per ton; he however has the use of the buildings and thirty acres of land, free of charge. Should the layer of plaster extend beyond the limit of the property on which the work hitherto has been done, Mr. Garland has arranged to have it mined on royalty. The yield in the direction of the new drift may be large. About 300 tons will be the output for the year.

Martindale Mine.

Two men were employed in the early part of the year at the Martindale mine, taking out plaster by contract. At the date of my visit in August work was suspended. Later on in the year some mining was done and about 200 tons were obtained as the season's output.

The Excelsior mine although closed down at the date of my visit in August was carefully examined, and in several places repairs were required to render it safe. Mr. Nelles, the manager, informed me that it would be substantially refitted before work was resumed. About 600 tons of plaster had been taken out in the early part of the year and shipped to Paris. *Excelsior Mine.*

In August the Teesdale mine was lying idle, but later in the season a considerable quantity of plaster was mined. *Teesdale Mine.*

EXPLORING FOR OIL AND GAS.

When at Sharbot Lake on September 16th, I met Mr. B. C. Steel of New York, who was engaged in boring for coil oil on behalf of himself and other American capitalists at Verona. The boring was being done on the property of Mr. George Smith, at a point known as High Falls in the northeast corner of the township of Portland, county of Frontenac, near Long lake, which empties into the Napanee river. Here is an excellent water power and a grist mill. The place of boring is in a basin or flat, and the surface formation is broken and rocky. Five men were employed at this date, and the drilling had reached a depth of 475 feet. The boring passed through hard pan from the surface for 15 feet, then 10 feet of very soft quick sand. Next came 70 feet of pyroxene and about 4 or 5 feet of asbestos, and underneath a layer of 5 feet of white quartz, beneath which the bore passed through 220 feet of slate rock, then 26 feet of open sand (or first sand) and next came blue slate rock which had been pierced 124 feet, in which the boring was being done at this date. The depth of 700 feet, I learn of recent date, has been reached. The bore is of 8 in. diameter for the first 175 feet, and then 6 in. diameter. Mr. Steel stated that it was intended the bore should go down 1,400 feet (if oil was not obtained sooner) before the venture should be abandoned. The whole equipment for boring is very complete. The parties interested in this enterprise profess to be sanguine that the great oil bearing anticlinal runs to the junction of the Potsdam sandstone with the Laurentian escarpment, near which they are operating. Drilling operations for oil in Portland township, in the county of Frontenac.

In the last report a short account was given of the gas wells at Caledonia. On November 28th I visited this location again and Mr. Walker, whose private well has been completed, gave me the following description of it. He says: "At the depth of 285 feet we struck a strong flow of sulphur water which rose 4 feet above the top of the well. At 375 feet we placed a casing $5\frac{5}{8}$ in. in diameter in the bore and cemented the casing to the rock with Portland cement, using four barrels of cement and one load of sand, which not only secured the casing but stopped the flow of sulphur water. At 380 feet we got our first supply of natural gas; a greater flow was obtained at 395 to 400 feet, when we struck the Red Medina formation. After going two feet in that rock the drilling was discontinued, as the flow of water was very strong with salt, with traces of oil. A half-inch pipe was put to the bottom of the bore and then by closing the top of the well the pressure of gas blows out the salt water. This on trial works well. A main has been laid from Walker's gas well at Caledonia.

the regulators to supply houses with the gas. The pressure at the well is 190 lb. Between the well and the regulators an oven is placed through which the gas passes, taking out the moisture before going to the regulators. It first passes through the high pressure regulator and is reduced to 25 lb., and thence passes through the low pressure regulator and is reduced to 4 oz., mercury pressure. This well supplies one furnace, 9 stoves and 40 burners, leaving a pressure on the well of about 150 lb., varying from 140 lb. at the lowest to 170 lb. at the highest. "I am satisfied" Mr. Walker says "that tha gas has increased in flow since we commenced to use it." Total cost of well, piping, etc., $1,350. Its production will reach annually in value a few hundred dollars.

Caledonia Natural Gas Company's wells.

A local chartered company has been formed composed of twenty citizens of the town, known as the Caledonia Natural Gas Company, Ltd., with capital stock of $3,000, all paid up, in shares of $25 each. Since Mr. Walker's well has been completed the company has drilled another well, which makes in all three now owned by them. The flow of this last well is exceedingly good. The pressure at well is 190 lb. and makes gas rapidly. A 2 in. pipe was placed in this bore when completed, and at the surface with a 2 in. opening when lighted the flame jets up 30 to 35 feet; it was left burning for a couple of weeks previous to being utilized for domestic use. The rock formation is the same as in Mr. Walker's well, excepting a layer of plaster which is only 2 feet in thickness, and the gas rock is slightly more porous. The company paid by contract $750 for drilling 450 feet. The return from the well to the company I was informed was about $45 per month above expenses. There are five producing wells in the vicinity at present.

Scott's well.

At a distance not exceeding 200 feet from the best flowing well belonging to the company, designated well No. 1 and between it and well No. 2, Mr. William Scott drilled a private well to the depth of 550 feet with unfavorable results. The formation was similar to that in the other wells, with the difference that the gas rock was very hard and but little gas accumulated. The overflow of sulphur water occurred the same as in the Walker well. As an experiment 50 lb. of dynamite was put down the bore from the surface 400 feet and exploded, but without producing any material change in the output. Although the location and boring would indicate a good return, the venture proved a failure, and the well has been sealed up to prevent the very unpleasant sulphur odor emitted from spreading over the neighborhood.

USE AND ABUSE OF DYNAMITE.

Improper handling of explosives.

I have had occasion frequently to call attention to the improper handling of explosives. For the safety of mine operators their attention is invited to the requirements of The Mines Act 1892, under the head of General Rules, section 74, subsection 2. It will also be of interest to all miners to note the following exhaustive and instructive paper prepared by Harry A. Lee, Commissioner of Mines for the State of Colorado, on the Manufacture, Use and

Abuse of Dynamite, which is reproduced in a recent number of the Engineering and Mining Journal of New York, in which he says:

"Under the most favorable conditions the manufacture of dynamite is a hazardous business, safety being entirely dependent upon the purity of the materials used and the skill and care of the workmen employed. In the manufacture of explosives as in all lines backed by American ideas and energy, the American product stands pre-eminent. Although the first plant was established in this country only a little over 20 years ago, the art has today reached that point of perfection, brought feats of engineering within the range of possibility, and exerted an influence upon modern civilization which entitle it to take rank with the application of steam power.

The manufacture of dynamite a hazardous business under the best conditions.

"The aim of the various powder companies is to supply a product which can be transported and handled with safety, give uniform results in blasting, keep in good condition when properly stored, and, as far as possible, neutralize all poisonous fumes when exploded. The explosives used almost universally throughout Colorado are compounds having nitro-glycerine for a base, commonly called by the miner "30% powder," or "60% powder," according to percentage of nitro-glycerine in the mixture.

Qualities of a good article.

"The strength of the American nitro powder is not, as is generally supposed, wholly dependent for force upon the amount of nitro-glycerine present in the mixture. The compound is composed of various elements, which in manufacture not only absorb the desired amount of nitro-glycerine, but are in themselves an explosive. In blasting, the exploder or cap, which is charged with fulminate of mercury, explodes the nitro-glycerine, and the nitro-glycerine in turn the remainder of the mixture. A line of experiments conducted by experts show that the force exerted by this combination exceeds that of the sum of the three exploded separately.

"The American dynamite of today is not an accident, but is the result of a long line of careful experiments, conducted by eminent chemists and demonstrated by practical tests. These tests, aided by great advances in the art of manufacturing, have demonstrated that the products can be handled with greater impunity than many other things common to transportation by common carriers. They have also demonstrated that the safety of the compound is dependent upon purity of the materials used and care in mixing. During the past few years competition among various powder companies has been so keen and bitter that gradually but steadily the cost of dynamite to the consumer has been reduced. It is a dangerous contest, and a rivalry in which, sooner or later, if continued, safety will be sacrificed. To be more explicit upon this point—skilled labor commands a certain price, likewise chemically pure nitro-glycerine. The two being the most expensive parts in the compound of dynamite, combined the product is a safe mixture. Unskilled labor and impure nitro-glycerine can be had for less money, but the product of this combination is a mixture subject to decomposition. Decomposition in such a compound is practically explosion. Decomposition may not set in for some time, and the great danger of the competition in the manufacture and sale of dynamite is that of forcing some of the competitors to use impure or cheaper

Progress of improvement in manufacture, and the risk of keen competition.

materials and labor in order to meet a lower price, and take chances upon decomposition not commencing before the stock thus manufactured is disposed of. This danger point may not as yet have been reached. The older powder companies have much invested and a reputation to maintain; the newer companies have much invested and a reputation to make. From the standpoint of safety however the bottom price is very little below the market price of today.

Storing the explosive.

"Powder should be stored in a dry, cool and well ventilated magazine built for that purpose. A brick or stone magazine is preferable to a frame, both on account of being affected less by sudden changes in temperature and freed from any danger of bullets from careless marksmen. When built of wood, the frame or studding should be covered inside and out with boards, and so set that the air can circulate all around, and the inner boards be but little affected by the heat of the hot sun. Caps should not be stored with powder.

A good article not affected by age.

"Regarding the age of powder: when powder has had proper care in manufacture and storage, decomposition will not set in. If there is no decomposition there is no chemical change, and under these circumstances powder ten years old or older is just as good and safe to handle as powder ten days old.

The safe plan for thawing powder.

"One of the main sources of accident is from thawing powder, and the only safe plan is the use of heat from hot water. The powder should not be dipped in the water, but placed in a watertight vessel and the vessel set in hot water, or a regular powder warmer should be made. These vessels can be obtained from any of the mechanical firms or from the powder companies at nominal cost. Do not place powder under or on a stove, or in the oven. Do not lay on boiler wall or on back plate of a boiler. Do do not heat around a blacksmith forge or over a burning candle. Do not lay on hot sand, or, in short, do not thaw powder with dry heat. Do not consider these precautions unnecessary, or reason that because you have done so many times there is no danger. An explosion is usually fatal, and numberless escapes in no manner reduce the explosive force. Powder freezes at from 40° to 44°F. Explodes when confined at from 320° to 360°F. From a quick application of dry heat powder is liable to explode at 120°F. A stick of powder heated to 120°F. can be held in the hand with little inconvenience, and this degree of heat is soon reached when placed on or about a stove. That frozen dynamite is liable to explode from heat quickly applied has been demonstrated many times, and to ignorance, non-appreciation or carelessness of this fact most accidents are due. If you have heated powder about a stove for years without harm, consider yourself fortunate and stop it. If the warning of those who make the powder have no effect, let the accidents constantly occurring from this cause convince you. If you cannot procure a powder warmer take a 5 lb. lard bucket, fill it with powder and set in warm water. If you have no warm water put some sharp rocks in the bottom of a larger vessel to keep the smaller vessel off the bottom, surround the inner vessel with water and set two lighted "snuffs" about an inch long under the big can, throw an ore sack over the whole, and in a short time the powder is in a good condition for use and no risk incurred. With slow

heat thus applied dynamite may be heated to the temperature of boiling water with safety. Do not use frozen powder to load a hole. It is unfit for use. If it explodes at all it will do poor work. If it does not seemingly burn or explode it may be smouldering or decomposing, and the dropping in of a spoon, a drill or the stroke of a pick or hammer be sufficient to explode what is left.

"Constant care in preparing a charge and in loading will avoid 'missed holes.' Next to warming powder with quick dry heat 'picking out a shot' is the cause of the most fatal accidents. If a hole 'misses' do not be in a hurry to return, and especially if the hole was tamped close. More accidents are caused from supposed miss holes than from actual. A small sharp rock may be tamped into a piece of fuse so that the fire will not pass that point for hours; this is often mistaken for a missed hole. The hole is picked out, this particular rock removed and an explosion follows. To fully demonstrate this, put some V-shaped clamps on a piece of fuse and see how long it will take to burn by certain points. Long after the fuse is supposed to be out, loosen the clamps and see how quickly it will spit at the other end. Some holes do miss fire and have to be picked out. In these great care should be exercised and not clean down nearer than 5 in. of cap, then reload with another charge, and instead of using a small piece of powder use plenty. A heavy charge on top may destroy the effectiveness of the lower charge, but it will explode it and get rid of a bad job. If the 'collar' of the hole is simply blown off and the lower charge has broken to the bottom of the hole, do not drop in a drill or spoon to see 'how much hole is left'; leave it alone as long as possible. The lower powder may have frozen, and all may not have been consumed. Warnings.

"Caps are charged with fulminate of mercury, one of the most violent explosives, and one of the most unstable chemically, and may explode from the slightest jar or least amount of friction. The caps at all times should be stored well away from the powder, and at no time in or around a miner's pocket. Care of caps.

"Powder should under no circumstances be stored underground. Poor ventilation with damp air will produce decomposition, and decomposition explosion. There is practically no danger in transporting powder in cases, and especially when frozen. Even well thawed powder will not explode from any of the jars occasioned by a wagon haul or pack train. A case dropped several hundred feet upon rock might explode, but separate sticks would simply break out of the wrapper and no explosion follow. Various suggestions.

"Powder will burn in the open air and not explode, providing the gases generated in the adjoining powder from the heat of combustion have room to escape. For example, place two boxes of powder side by side, open one and ignite, leave the other box closed. The burning box will not explode, but the heat will explode the closed box."

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